INTER AVIA

Review of World Aviation

In this Issue :

THREE DECADES OF IATA

Pillars of World Air Transport — I.A.T.A.'s Seventy Members

Progress in Pictures — Research at Work

Ansel E. Talbert : America's Air Navy of the Future

Cdt. Coutaud : Problems of Fighter Interception

VOLUME IV No 9 SEPTEMBER, 1949

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INTERAVIA

Review of World Aviation

OFFICIAL ORGAN OF THE FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE (F.A.I.)

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Front cover :
Inside the U.S. Navy's Troop Carrier, the Lockheed "Constitution"

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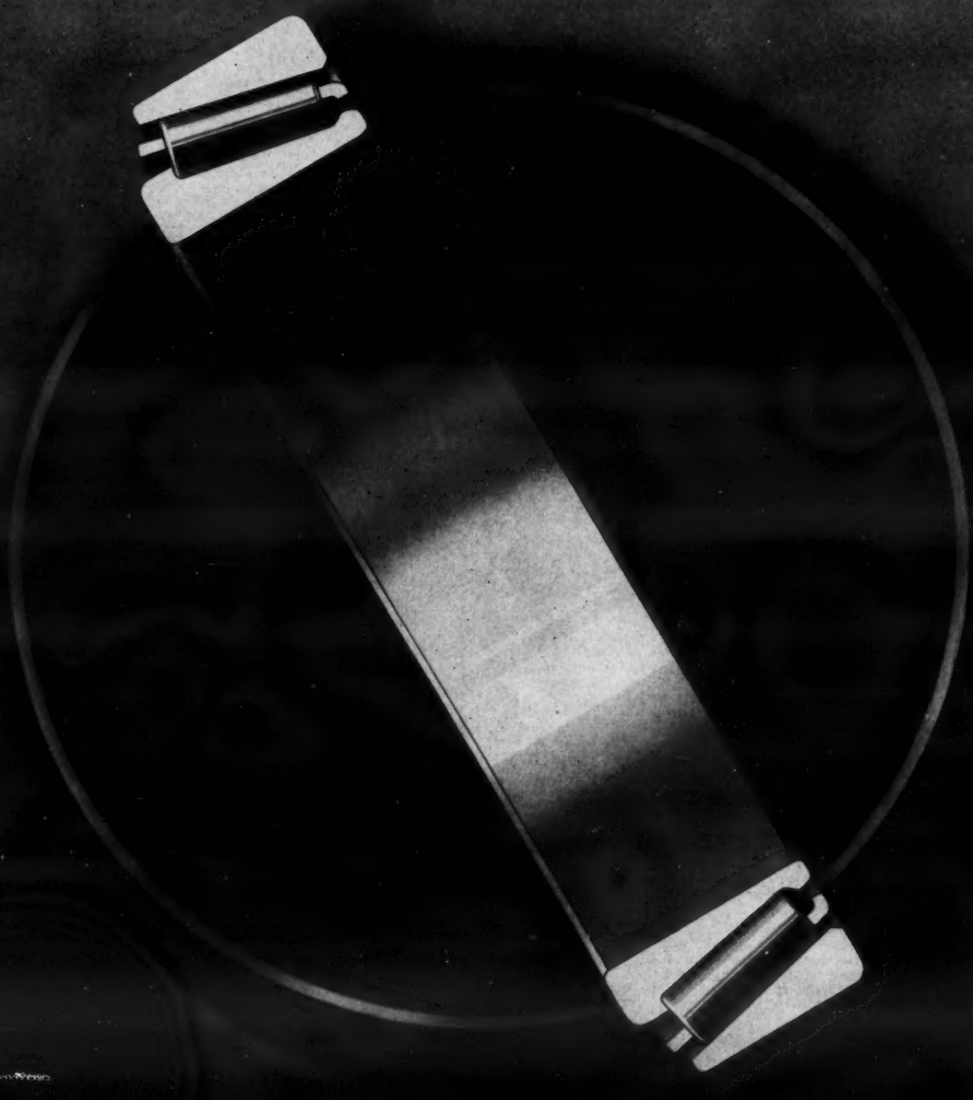

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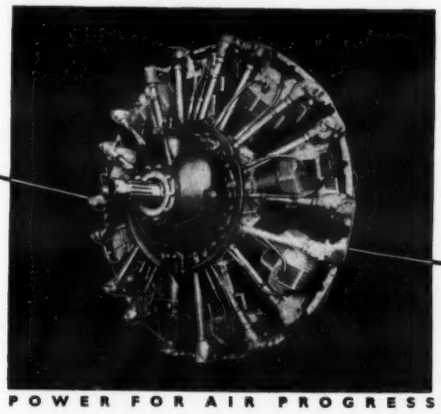
TAKING OFF TO MAKE NEW AVIATION HISTORY

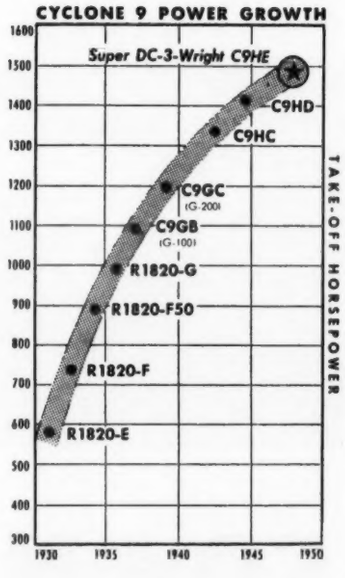
... the Cyclone-Powered Super DC-3



POWER FOR AIR PROGRESS

It's a *high-powered* take-off ... because the Douglas Super DC-3's power plant is the CYCLONE 9HE ... *rated* at 1475 horsepower for improved take-off performance.

With its improved power, speed and range characteristics, the new Super DC-3 with the Cyclone 9HE adds another chapter to aviation history ... moves to new performance records as Cyclone-powered Douglas twin-engine transports have been doing for sixteen years. And remember ... in 1933, the Douglas DC-1 took off with a 715 HP "9" ... a powerful engine for those days. Then came the DC-3 to raise operational standards several notches higher with its Cyclone "G", first air-cooled radial to develop 1000 horsepower.



Today, the swift new Super DC-3 *takes off* with the Cyclone 9HE—with "9" *features that pay off aloft :*

1. **More power ;**
2. **Low weight to HP ratio ;**
3. **Low fuel consumption ;**
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9. **A 16-year background** in airline service.

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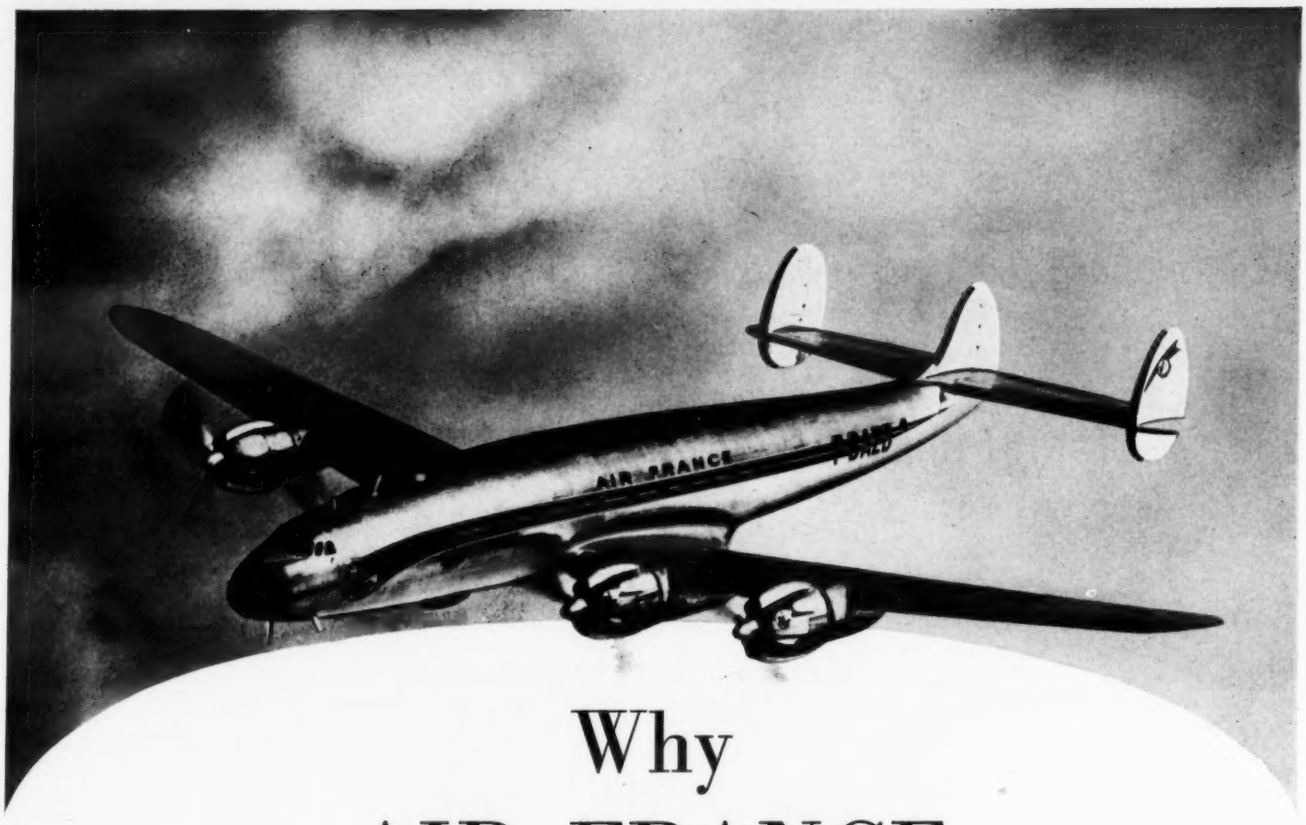

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AIR FRANCE
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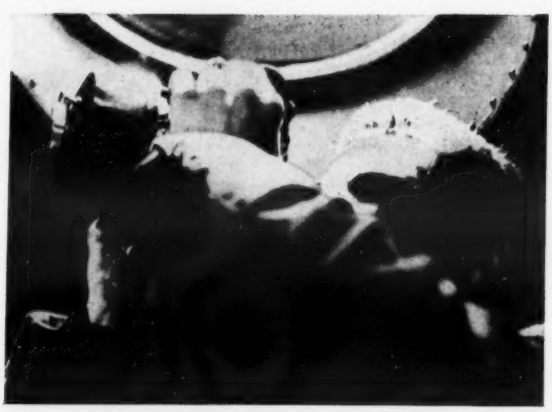

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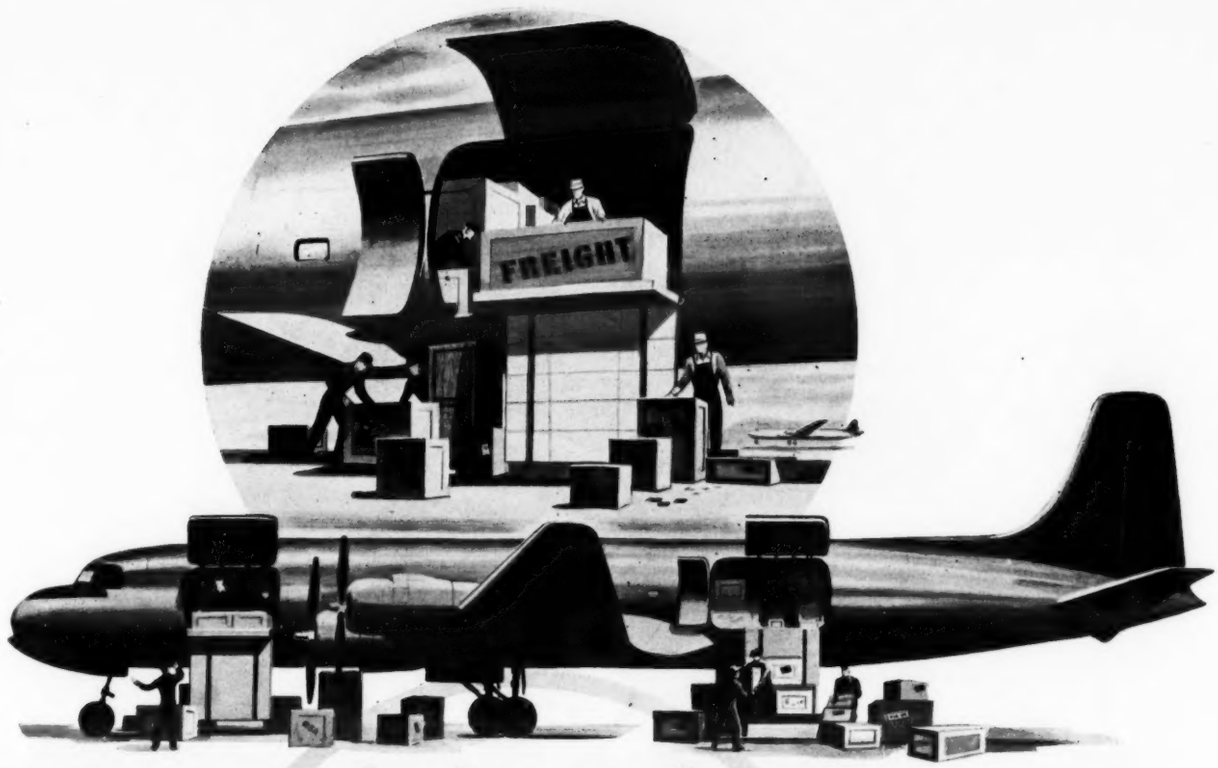

Douglas opens the door on the new

air FREIGHT age

What the *Liftmaster* will do for the coming *Air Freight Age*

- *2 planes will do the work of 3*
- *3 maintenance men will do the work of 4*
- *2 units of money will do the work of 3*

Skies throughout the world will soon throb with the power of a giant new super charged air freighter — as the **Douglas DC-6A Liftmaster** speeds 15 tons of freight to distant places at 300 miles per hour!

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Here is the all-cargo version, demanded throughout the world, of the famous **DC-6**—the aircraft already proven supremely dependable in billions of passenger flight miles.

Pioneer of the Air Age, Douglas now helps bring about the Air Freight Age. For the faster shipment of larger cargoes in the **DC-6A Liftmaster** will be a revolution in the economic progress of all nations!

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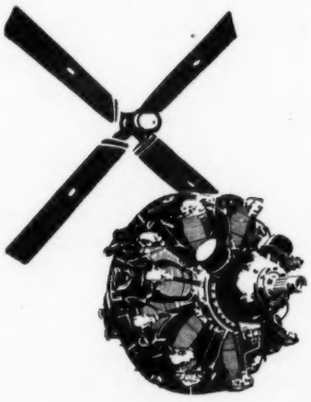
DOUGLAS

DC-6A LIFTMASTER *(now assembling)*

D5

Douglas Aircraft Co., Inc., Santa Monica, Cal. - Européan Division - Aérodrome de Haren, Brussels, Belgium

DEPENDABILITY ON THE BERLIN AIRLIFT



The Berlin Airlift dramatized the role of the airplane in the field of transportation. It also demonstrated, once again, the rugged dependability which is built into every Pratt & Whitney engine and Hamilton Standard propeller.

Such dependability was vital to this huge operation. In one peak day an airplane landed and took off *every sixty-one seconds* at Tempelhof in Berlin. In that one day alone, 1,398 flights were made into the city carrying a total of 12,941 tons of food, medicine and fuel.

These products of United Aircraft played an important part, for every airplane used by the United States as well as many of those used by Great Britain, were powered by Pratt & Whitney engines and, with few exceptions, *all* aircraft were equipped with Hamilton Standard propellers.

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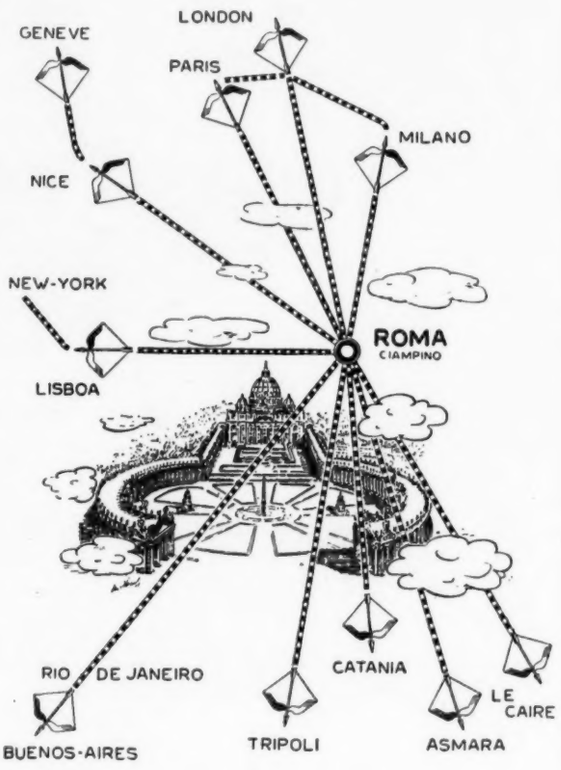
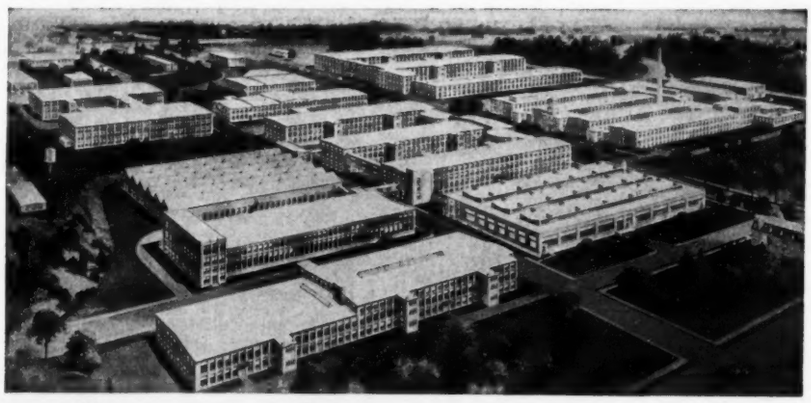


Shown is the large group of buildings housing the activities of Pioneer Parachute Company and Cheney Brothers



A DECADE OF PROGRESS

PIONEER leads the world in parachute manufacturing

Pioneer Parachute Company, foremost parachute manufacturers, working in close cooperation with Cheney Brothers, world-famous weavers, form the team that has made possible the research, engineering, testing, weaving and manufacturing from the raw product to the finished parachute. It is this coordination of personal "know how" and manufacturing facilities backed by vast resources and high standards of workmanship that unquestionably places Pioneer parachutes in the vanguard of aviation progress. Pioneer parachutes are preferred by test pilots and aviation manufacturers and are standard equipment with many government air forces the world over.

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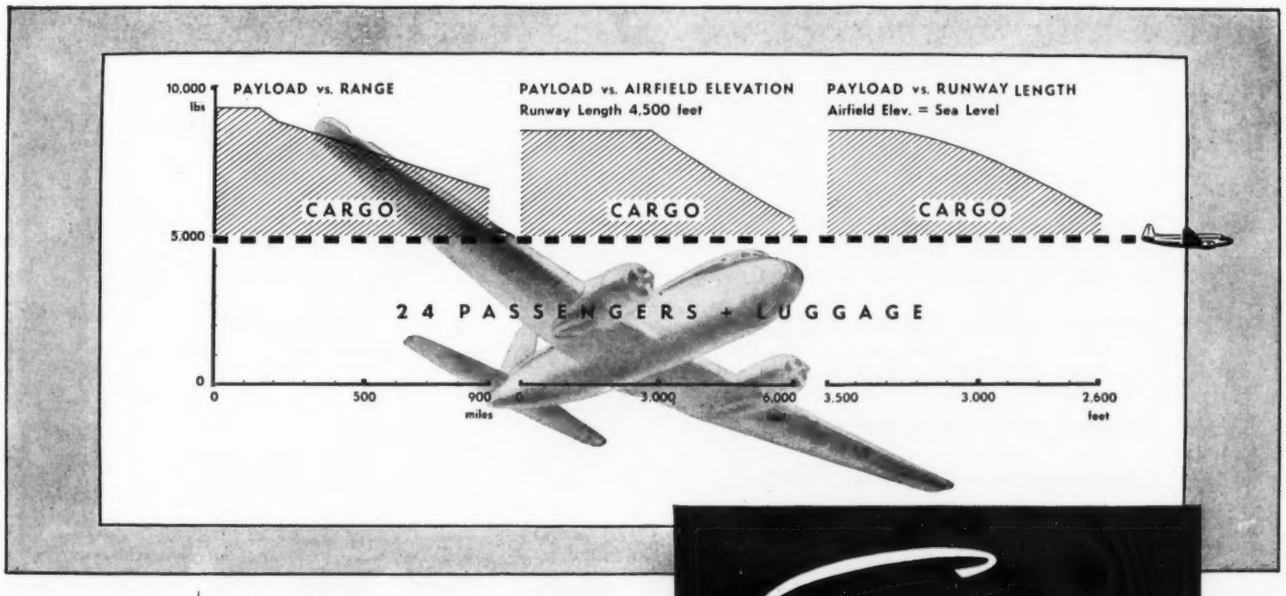

CONDITIONS

Cruise Altitude	10,000 feet
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Between departures and arrivals ... SABENA'S MENUS

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FLY
TO THE
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FIFTH ANNUAL
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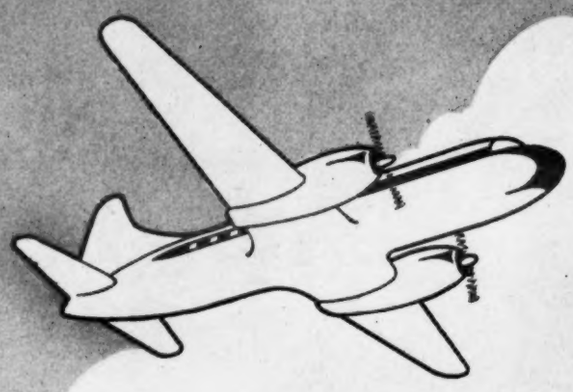
ON
SEPT. 12-16
AT THE
HAGUE . . . ***Quickly, Comfortably and Safely***



ABOARD

CONVAIR-LINERS

IN SERVICE
WITH

K.L.M. ROYAL DUTCH AIRLINES
SWISS AIR LINES
AND *SABENA*

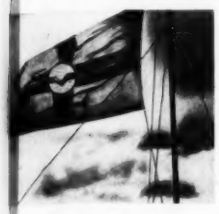
CONSOLIDATED VULTEE AIRCRAFT CORPORATION

San Diego, California — Fort Worth, Texas

Three Decades of IATA

(The International Air Transport Association will hold its Fifth Annual General Meeting at The Hague from September 12th to 16th, 1949)

Why should Mr. Jones bother about IATA?



In his dentist's waiting room Mr. Jones pages through the illustrated magazines. "Where Does Marlene Dietrich Spend her Summer Vacation?" Jones thinks it's worth reading.—"True Story of Giuliano, Sicily's Bandit King." Jones' spine is chilled.—"Jet Plane Reaches New Speeds." Not bad either. The pictures are usually good, the speed is within the bounds of imagination, and it provides a subject for general conversation.—But "IATA Celebrates Thirtieth Anniversary at The Hague." Mr. Jones isn't interested enough even to read right through the headline. What's IATA to Mr. Jones, anyhow?

Coming out of the dentist's he remembers he has a letter to post, a letter bearing a Swiss address. "By air mail, please!" "Goes by airmail anyhow," replies the post office employee. "No surcharge between England and Switzerland."

A pleasant surprise, isn't it, Mr. Jones? But maybe you don't know that you have just encountered one of the numerous instances where IATA, the International Air Transport Association, has successfully fought to simplify your everyday life.

During this century's 'twenties a British writer stated one had the impression that humanity was "stumbling" into the air age. Today, almost thirty years later, we are still only on the threshold of the air age, but we can nevertheless say with certainty that the "stumbling" would have been very much worse had there been no IATA.

They knew what they wanted

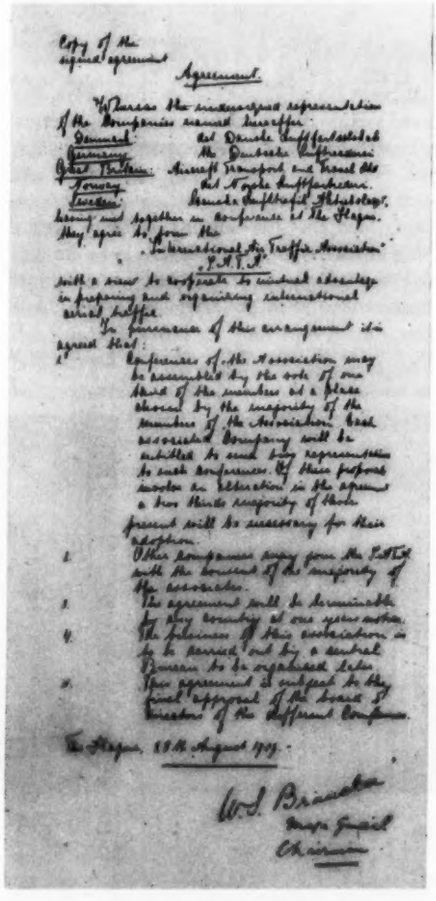
There was ample occasion for "stumbling" for those twelve men who, at the end of August, 1919, met at The Hague in order to found a representative body of a branch of transport which hardly existed. The company headed by the man who issued the invitations for the meeting, George Holt Thomas, had just a few days beforehand been registered in London under the name of Air Travel & Transport, Ltd., and begun operations over the London—Paris route on August 25th, 1919, with a single de Havilland "Airco." The Nederlandsche en Koloniale Luchtverkeer Maatschappij—later to become K.L.M. Royal Dutch Airlines—was in the process of formation at the time, and its representatives had not yet the power of attorney. And although the title "airline company" was claimed by each of the four other founder companies—Det Danske Luftfartselskab, Deutsche Luftreederei, Det Norske Luftfartrederi, and Svenske Lufttrafik Aktiebolaget—there is no escaping the fact that civil air transport was in those days wishful thinking, a hope for the future, but not a reality.

Not one of the companies represented at The Hague could look back upon a complete twelve months of operations. None of the airline executives was in a position to give precise information on the near and far goals of civil air transport. But despite this, those twelve men did not "stumble" into the air age. They knew what they wanted.

At a public relations conference held by IATA last May in Oslo, Mr. Gill Robb Wilson, aviation columnist of the New York *Herald Tribune,* who was invited to address the meeting, said that, to sell civil air transport successfully to the public, a man must be "so thoroughly saturated with the technical progress, the development steps and the possibilities of aviation that he glows with the spirit of a crusader . . ."

Such is the stuff from which IATA's founders were made.—*Sir William Sefton Brancker,* who was to become an Air Vice-Marshal and the Director of British Civil Aviation, made his first flight in 1910 as a military observer in a Bristol "Box-Kite," learnt to fly in 1913, and devoted all of his dynamic energy to further world aviation until his death on October 5th, 1931, in the disaster to the airship R 101. *George Holt Thomas,* who took an avid interest in flying as early as 1906 and, after witnessing the birth of European flying a year later in France, had the French aviators come over to England to stage exhibitions, was among Britain's earliest aircraft manufacturers and airline operators, founding Aircraft Manufacturing Co. Ltd. in 1911 and Air Transport & Travel Ltd. in 1919. *Walter Mackenthun,* the German military flyer who, in 1910, attempted the first long-distance overland flight, associated himself with *Dr. von Rieben* and founded the Deutsche Luftreederei. *Willie Wulff,* a Danish sculptor, put his whole fortune into the foundations of Denmark's commercial air transport and, together with Captain *H. C. Ulldtz,* ran Det Danske Luftfartselskab. *Edgar Field,* the Dutch banker who later became K.L.M.'s financial adviser, lost his life in the Prestwick crash of October, 1948. *Jonkheer van den Berch van Heemstede* was a member of the K.L.M. delegation at the founding meeting, Secretary General of IATA from 1920 to 1927 and henceforth its General Manager until his retirement from active association in 1939. At that first meeting there were also the Norwegians *M. Delbi* and *W. Keilhau,* and *M. Jacobson* from Sweden.—As varied as may have been the origins of these men, they all spoke the same language, they were all endowed with the same will to create a European air transport system, aye, a world air transport system, and, come what may, to keep it alive.

The first compact of the free association of international airlines was this short agreement, handwritten and signed by the Chairman of the session, Major-General Sir W. Sefton Brancker, at The Hague on August 28th, 1919.



Copy of the signed agreement

Agreement.

Whereas the undersigned representatives of the Companies named hereafter

Denmark: Det Danske Luftfartselskab
Germany: Die Deutsche Luftreederei
Great Britain: Aircraft Transport and Travel Ltd
Norway: Det Norske Luftfartrederi
Sweden: Svenska Aktiebolaget Lufttrafik

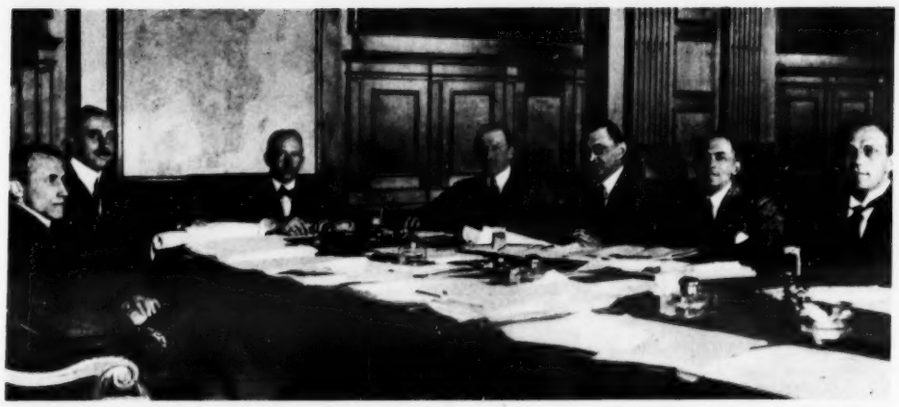
having met together in Conference at The Hague. They agree to form the "International Air Traffic Association" I.A.T.A. with a view to co-operate in mutual assistance in preparing and organising international aerial traffic.

In furtherance of this arrangement it is agreed that:

1. Conferences of the Association may be assembled by the order of one third of the members at a place chosen by the majority of the members of the Association. Each associated Company will be entitled to send two representatives to such conferences. All these proposals involve an alteration in the agreement a two thirds majority of those present will be necessary for their adoption.
2. Other companies may join the I.A.T.A. with the consent of the majority of the associates.
3. The agreement will be determinable by any country at one year notice.
4. The functions of this association is to be carried out by a central Bureau to be organised later.
5. This agreement is subject to the final approval of the Board of Directors of the different Companies.

The Hague, 28th August 1919.

W. L. Brancker
Major General
Chairman



The oldest photo of a IATA semi-annual meeting, held at Stockholm in 1921. Whereas four airlines and an observer made up this meeting of the old IATA, full annual meetings of IATA today bring together the representatives of 70 or more airlines and international organisations from all parts of the world. Left to right : K. Lignell, A.B. Aerotransport ; Jonkheer I. L. van den Berch van Heemstede, General Manager of the old IATA ; a representative of A.B.A. ; W. Meisterlin, corresponding member of IATA for Norway ; W. Wulff, Det Danske Luftfartselskab ; M. Wronsky, Deutsche Luftreederei ; Albert Plesman, K.L.M. Royal Dutch Airlines.

Not to be forgotten is the young Dutch Air Force Lieutenant, *Albert Plesman,* who did not figure among the first IATA founders as he then had his hands full with the organisation of Holland's first aviation exhibition, the ELTA, but gave his full backing to the founders' meeting and has been a staunch IATA supporter ever since.

If, after thirty years, we take up the short agreement hand-written and signed on August 28th, 1919, by Sir Sefton Brancker, and read through the terse phrase outlining IATA's goals :

"... agree to form the International Air Traffic Association, I.A.T.A., with a view to cooperate to mutual advantage in preparing and organising international aerial traffic ..." we cannot help but be astonished at the farsightedness and clarity of purpose revealed by those founders of civil aviation.

It must be recalled that, in those days, the broad section of the public understood aviation to be either military aviation or sporting flying, that the carriage of passengers was looked upon, at the best, as a very sporting undertaking, and that no one had heard of such a thing as air freight. Also, it should be realised that the examples set by the international organisations then in existence, could have misguided rather than guided IATA's founders.

The shipping conferences which were convened occasionally by international shipping circles in order to reach common goals, embodied principles that were diametrically opposed to the endeavours of the IATA member companies. These shipping conferences were, in principle, exactly the opposite of what IATA's founders had in mind for an air transport association. They had, as practically sole purpose, to fix tariffs, and served as safety valves to prevent overheated competition.

IATA, in the minds of its creators, was to be a *family council of air transport operators.* That is what it became and—despite all crises, battles and confusion—that is what it has remained until today.

Public, politics, private interests ...

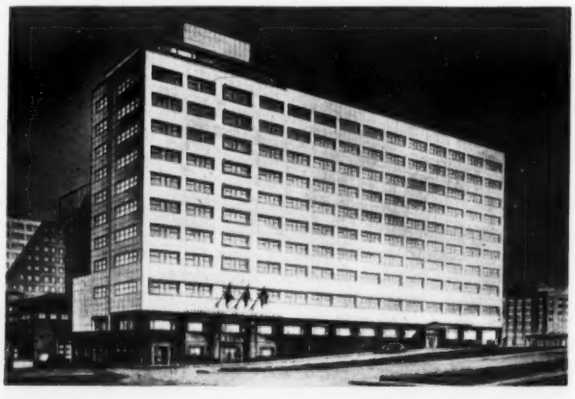
No, IATA wished to be neither a trust nor a cartel. No gigantic administrative apparatus was erected ; the organisers were content to create a few posts, almost exclusively honorary appointments, and attached priority value to twice-yearly meetings which, held in February or March and July or August of each year, united the representatives of the member companies in various cities of Europe. These conferences became the only organ through which the members expressed their common aims. Regardless of its commercial importance or the size of its financial contributions, each member company had one vote. Free from obligation, they jointly made such decisions as would help promote civil aviation in general, and left the execution of those decisions to the good will of the members.

Commendable as all this may sound, the thorny tasks IATA decided to tackle during its first decade of existence nevertheless presented many a great difficulty because of this concept of complete liberty. As a purely private association of certain—not all—airline companies, it had to come into contact with governments and big international organisations, and with these it was not on a par as regards power.

IATA had no seat on the International Commission for Air Navigation, ICAN, the inter-governmental organisation with headquarters in Paris, whose decisions then governed the ups and downs of civil aviation. IATA had no access to the body which governed international aviation law, the Comité International Technique d'Experts Juridiques Aériens, CITEJA, also based in Paris. Only indirectly was it able to influence the decisions formulated by those organisations, by impressing upon its members, at the bi-annual meetings, the importance of drawing the attention of their respective governments to this or that urgent problem. And it was frequently the case that, not only did a smaller or larger income of the member companies depend upon the solution of those problems, but the further existence of civil air transport in its entirety.

Some customs administrations demanded that airlines serving the country should previously make a temporary general application for the entry of their aircraft, listing all machines which might carry out the service and detailing their characteristics. If, due to engine trouble or some such setback, an aircraft had to be replaced, and this aircraft was unlisted, it was turned back without further ado, however well registered and vouched for by another government. If an aircraft was blown off its course while crossing a frontier, it could not proceed to its original destination but had to land at the nearest customs airport instead. In the event of a forced landing, pilots had to stay until authority to leave was given them by customs and immigration officers who might be hundreds of miles away and remote from the telephone. Other customs administrations not only levied duty on goods and even baggage in transit, but made no provision for the event of an aircraft landing briefly for fuel and departing again with its passenger list and payload intact. And whilst some countries demanded a full set of papers for every landing, covering passengers, crew members and goods, there was not even any definite understanding throughout Europe as to what sort of documents were required. Thus

The first Central Office of the old IATA was housed in this building at Paulownaplein 3 at The Hague. It was simultaneously the old office of K.L.M.
The projected "International Aviation Building" at Montreal, designed to house IATA and ICAO.



Dr. H. J. Goreoki, Treasurer and Secretary of the IATA Financial Committee.

Sir William P. Hildred, Director-General of IATA.

J. Alan MacD. Henderson, Secretary of IATA.

it happened that the French CIDNA airline had thirty pilots who could not enter Turkey, and fully half of the line's flight personnel was forbidden entry into Rumania.

Prohibitive taxes on fuel, dual taxations, mountains of red tape . . . there was no dearth of urgent jobs to tackle. And IATA could, in fact, do no more than send its member companies' delegates home with new desires for reforms and improvements—desires which sometimes materialised, sometimes came to nothing.

*

Bureaucratic red tape was not to be the only obstacle in the path of the early IATA. In the pursuance of its real aims it encountered difficulties as varied as they were discouraging.

In order to bring passengers to use the airlines, internationally valid timetables had to be drafted. How could these be reliable if the individual nations adhered to different Summer and Winter times and regulated the transition from one to the other according to entirely different concepts ?

It was aimed to urge the post offices to introduce air mail services without surcharge and the railways to provide suitable connections. A difficult undertaking indeed, seeing that most airline companies restricted their operations to eight months each year (and, calendarwise, not always the same months) and even during these periods were constantly compelled to alter their schedules.

The insurance companies had little confidence in this young branch of transport, and demanded premiums which were hardly short of prohibitive (up to 20 per cent. of the object insured). Then, the indemnities offered by insurance companies were pitifully low in comparison.

Stanislaw Krzyczkowski, Secretary, IATA Technical Committee.

S. Ralph Cohen, Public Relations Officer of IATA.

A. J. Quin-Harkin, Manager of the IATA Clearing House in London.

In order that the cup should be filled to the brim it was not infrequent that the member companies entertained different opinions on matters which concerned all of them. Thus, there were a few heated arguments before a more or less satisfactory compromise was reached on the amount of free baggage allowed each passenger. Fifteen kilograms were finally conceded, with the specification that passengers could carry, free, such items as coats, rugs, umbrellas, walking sticks, ladies' bags, still or motion picture cameras, and briefcases—one to a passenger and up to a "reasonable" weight.

Revealing of the informal way in which air transport matters could be handled twenty-five years ago were the IATA discussions on whether children should be charged the full or half the fare. After some argument it was finally at the suggestion of Albert Plesman, President of K.L.M., that it was decided to carry free, children under three if they sat on a passenger's knee. The rate at which children from three to seven would be carried was left to the discretion of the airport manager at the time of embarkation.

*

IATA had no executive power. It could not compel its members to accept and execute the regulations it suggested. On the contrary, it had to do everything possible to keep its members "in a good mood," in order that these should not go over to IATA's competitor. For there was such a competitor, and it constituted no small worry to IATA.

The story is briefly this. The German Junkers aircraft manufacturing concern, which had grown enormously during World War I, found themselves up against a brick wall at the end of hostilities. The very small orders for private and transport aircraft could not compensate the entire loss of the firm's war contracts. And the peace treaty conditions forbade further military production. Junkers, if they did not wish to liquidate, had to find an outlet for their manufacturing potential. But this required first of all an activation of commercial aviation—and commercial aviation under the German flag or at least under the control of this German aircraft concern. Junkers took the commercially logical step and concerned themselves with the organisation of European air transport. They propagated the "Trans-Europa-Union," a cartel formed to compete against the British and French air operators, and which embraced, in addition to Germany, the Baltic and

The Secretaries of the three IATA Traffic Conference. Left to right : R. Feick, New York ; V. de Boursac, Paris ; H. J. Dedekam, Singapore.

Scandinavian countries, Switzerland, Austria and Hungary. In a widely-circulated pamphlet entitled "Luft-Hansa"—a name adopted by the later German airline group—Junkers' press officer, Fischer von Poturzyn, estimated that while in 1924 the British airline network comprised only 1,580 kms., the French network embraced 5,480 kms., but that the "Union's network" had grown to 5,796 kms. Poturzyn continued in terms which made no mystery of Junkers' intentions :

"The attempts to render Germany geographically unimportant with respect to civil air transport will ultimately fail, just as did the former decision, based on French hegemonic politics, that the Simplon Express would run via the Simplon and Trieste . . .

"Great care must therefore be taken that German aviation policy be based on the concept of equal rights for all participant countries, but that in those instances where such justified cooperation is denied us, we do not hesitate to bring the Reich's geographic situation into evidence by decreeing aerial barriers."

Thus Mr. Poturzyn was neither very sympathetic towards IATA, nor did he reveal any great understanding of this free association's aims. To his mind it was an organisation created by K.L.M. and Fokker to compete against England . . .

"Another line of air-political tension now lies between London and Amsterdam. Immediately following the war Holland developed a well-managed, agile air transport policy, which had its industrial roots in Fokker, was based on K.L.M. from the traffic standpoint, and relied on IATA for its international scope."

Nowadays the Trans-Europa-Union has long been forgotten, the intrigues and battles of the inter-war period belong to the past, but IATA still lives and works.

These little pins moving across the rows of this master chart in Montreal indicate the fate of the IATA Traffic Conference resolutions. A full horizontal row of pins means that a resolution concerning tariffs, schedules, conditions of carriage, etc., has been approved by all of the individual and joint Conferences and by interested governments. The historic meeting of the first world-wide IATA Traffic Conference at Rio de Janeiro in 1947 reached full accord on almost 400 separate resolutions.

IATA is dead ! Long live IATA !

If one were to relate in detail how IATA overcame its many internal and external difficulties, how it conquered the timetable obstacles through frequent timetable conferences in Berlin, how it achieved agreement on questions of airline tickets, freight forms and luggage, how it supplemented the governments' Warsaw Convention by publishing its own "Conditions of Carriage" (reproduced on all tickets issued by IATA member airlines), how it established a comprehensive telegraphic code, and how—notably during its second decade—very successfully tackled the problems of improved and standardised navigational procedures, then this article would be anything but attractive reading.

IATA's early history is not spectacular. Between the few climaxes there lie months and years of silent, detailed work, carried out without pomp or ceremony at the modest Hague headquarters by the special committees and under the aegis of the plenary sessions.

At its 38th general meeting in Budapest, one year before the outbreak of the second world war, the old IATA reviewed its ranks for the last time. On its roster figured twenty-nine airline companies from twenty-four countries. It had forged a link with the New World and, for the first time, a representative of U.S. civil aviation was to have been the chairman at the next IATA general meeting in New York.

That meeting was never held. The war intervened, putting a temporary stop to civil aviation and consequently to IATA.

Thanks to the unselfish, dogged activity of the IATA Central Office at The Hague, and notably of Dr. D. Goedhuis, the Association's General Secretary, not only was IATA's capital saved from the German occupation and moved to London, but also the old pioneer spirit of civil air transport, which crossed the Channel and later the Atlantic.

In the wake of the Chicago aviation conference, a new IATA was founded in December of 1944. The one-time International Air *Traffic* Association became the International Air *Transport* Association. The central office of world civil air transport was no longer at The Hague. The new organisation's headquarters were now in Montreal, Canada.

In addition to the old tasks, the new IATA was now confronted by new problems. Together with its contemporaries it lived in a world whose economy had been completely dislocated. Currency and currency-exchange problems of the member companies had to be solved, and to this end the IATA Clearing House was organised, which already has a very fine record. The impending danger of harmful tariff wars was forestalled by Regional Traffic Conferences, whose activity so far has produced much more tangible results than the tedious negotiations of diplomatic meetings with gigantic administrative organs.

The IATA Clearing House, which transacts accounts between member airlines and circumvents exchange difficulties, is on the second floor of this building (30, Curzon Street) in London.

Facilities and personalities have changed. Numerous companies passed from private into government ownership. But the original idea of democratic joint action by free and equally privileged companies from all civilised countries has nevertheless remained intact. In fact, this basic principle of IATA has even been strengthened as much as possible in recent years. As always, the Association is a fierce opponent of every kind of bureaucracy —a trait which is revealed in the fact that its central secretariat in Montreal and its branch offices throughout the world together have only about one hundred officials and employees. It is certain that this allergy of IATA to anything bureaucratic is strongly inspired by the Association's Director-General, Sir William P. Hildred, who, as a former government man himself, knows the weaknesses of "over-organisation."

When this year's President of IATA, Dr. h. c. Albert Plesman, opens the new Association's Fifth Annual General Meeting on September 12th at The Hague, it will signify that IATA can look back upon three decades, rich in labour, during which that small European air transporters' union of 1919 has grown into today's globe-spanning association of scheduled airlines.

IATA

Pillars of World Air Transport

A "Who's Who" of the International Air Transport Association

Seventy airlines are members of the International Air Transport Association and thus qualify for the description of "pillars" of world air transportation. Sixty-four of them are Active Members of I.A.T.A., six are Associate Members. The difference in the two types of membership is that Active Members are engaged in international operations, whereas Associate Members fly domestic routes. Most of the Associate Members, however, operate services which are neither domestic nor truly international, or else they are preparing to enter the international field in the near future.

Sixty-four international airlines seems to be a very large number. It is less impressive if it is considered that there are well over 250 regular scheduled airlines operating in all parts of the world to-day. Some of these—notably in the U.S.A.—are larger than many I.A.T.A. member lines. In addition, there are 3,000-plus irregular, contract and air taxi operators in every corner of the globe. It would be interesting to know how the volume of business done by all these thousands of non-I.A.T.A. members compares with the performance of the I.A.T.A. companies : one might safely say that the contribution of I.A.T.A.'s members represents a very large proportion of the world's total air traffic volume.

The histories and present status of the I.A.T.A. members are dealt with in the following pages. Associate members are designated by an asterisk. Details of management, capitalization, air fleet and total route mileage appear in tabular form on pages 538-540, under the number carried by each individual airline "case history." The Editors have carefully sifted the material available for this compilation ; should any gaps or inaccuracies be discovered, however, they cannot fairly be held responsible for them.

European Airlines

The British Airways Corporations

Airways Terminal, London's city terminal for overseas services.

The present organization of the three British airlines is the third, though not the final, stage in the evolution of British scheduled air transportation. The first stage began in 1923 when the Government-subsidized Imperial Airways was established through the merger of several private airlines (Handley Page Transport Ltd. ; Instone Air Line, Ltd. ; Daimler Airways ; The British Marine Air Navigation Co. Ltd.) ; the second stage was initiated in November, 1938, with the Government's announcement that Imperial Airways was to be merged with British Airways—a vigorous competing company —into a single public utility corporation to be known as British Overseas Airways Corporation ; the third stage was marked by the Civil Aviation Act of 1946 which provided for the establishment of three Government-owned corporations : British Overseas Airways Corporation, British European Airways Corporation, and British South American Airways Corporation. A fourth stage will open shortly with the merger of B.S.A.A.C. and B.O.A.C. ; this is not expected to be consummated for some time, due to the entanglements inevitably resulting from the necessary transfer of B.S.A.A.C. flying rights to the enlarged B.O.A.C.— The 1946 Act empowered the Minister of Civil Aviation to make grants to the corporations to cover losses up to the following amounts : £10,000,000 for the fiscal years ending March 31st, 1947 and 1948, £8,000,000 thereafter. So far the corporations' losses have exceeded these grants.

1 British Overseas Airways Corporation (B.O.A.C.)

Airways Terminal, Buckingham Palace Road, London, S.W. 1.

The Corporation came into being after the outbreak of war, namely, in 1940, but performed valuable services with makeshift aircraft during the period of hostilities. Its post-war expansion as the Government's international flag carrier was often handicapped by lack of suitable equipment, a state of affairs which has now largely been remedied through the purchase of modern American and British aircraft. In 1945 B.O.A.C. opened landplane services to Australia and South Africa, in 1946 it established a landplane service to New York and a flying-boat service to Hong Kong ; in 1947 it opened services to Ceylon and Dar-es-Salaam and to West Africa across the Sahara. Finally, a flying-boat service to Japan was inaugurated in 1948.

Principal routes : England—Middle East—India—(Far East)—Australia ; England—South Africa ; England—West Africa ; England—North America.

Miles Thomas.

Sir Miles Thomas, Chairman

2 British European Airways Corporation (B.E.A.C.)

Keyline House, Northolt, Middx.

B.E.A.C. was formed on August 1st, 1946, from the British European Division of British Overseas Airways Corporation and nine private airlines to constitute the "chosen instrument" for air transport in the United Kingdom and within the Continent of Europe. In addition to services already operated by the former B.O.A.C. European Division, B.E.A.C. in the first year started regular schedules to Prague, Rome, Berlin, Ankara and other cities. The network has been further expanded since, and in the 1947-1948 year B.E.A.C. achieved a regularity of 95.5 % on 85,965 services scheduled.

Principal routes : London, Birmingham and Manchester to 25 European stations ; internal routes serving about 30 stations.

Douglas of Kirtleside

Lord Douglas of Kirtleside, Chairman

3 British South American Airways Corporation (B.S.A.A.C.) B·S·A·A

Starways House, King Street, London, S.W. 1.

The establishment of a British air service to Latin America was planned prior to World War II by British Airways. The War put a stop to this project, and it was not until early 1944 that any action was taken. At that time five British shipping companies organized British Latin American Air Lines Ltd., which was changed to British South American Airways Ltd. shortly after. Operations were started on January 21st, 1946. Early in 1946 B.O.A.C. bought the airline from the shipping companies for £50,000 and then sold it for the same amount to the present B.S.A.A.C. when that corporation was formed on August 1st, 1946. B.S.A.A.C.'s operations have chronically suffered from the lack of suitable flying equipment, since the company's new Avro "Tudors" were subject to long delivery delays. When two of the new aircraft disappeared on the South Atlantic run without a trace within a year, the Government grounded the "Tudors." As a result of the ensuing inability of the company to continue efficient services and in view of the public clamour for reorganization, Parliament has just passed an Act providing for the merger of B.S.A.A.C. with B.O.A.C.

Principal routes : London to Rio de Janeiro ; Buenos Aires ; Santiago de Chile ; Havana ; Bahamas.

John W. Booth,
Chairman and Managing Director

4 Aer Lingus Teoranta

Upper O'Connell Street, Dublin.

Aer Lingus was founded in May, 1936, as the Irish national airline and started operations with a number of services to important centres in Britain. During the war years its activities were restricted to a route between Dublin, Liverpool and Manchester. When Shannon became a pivotal point in post-war trans-Atlantic air traffic, Aer Lingus assumed considerable importance as a feeder operator between the Irish Atlantic terminal and commercial centres in England and on the Continent. — Aer Lingus' parent company, Aer Rianta Teoranta, was also established in 1936, primarily to foster the general development of civil aviation in Ireland and to act as a holding company. It owns 60 percent of Aer Lingus and in turn is owned by the Irish Ministry of Finance ; 30 percent of Aer Lingus is held by British European Airways Corporation and 10 percent by British Overseas Airways Corp.

Principal Routes : Shannon to Dublin and London ; Dublin to London, Liverpool, Birmingham, Glasgow, Manchester, Amsterdam, Paris.

J. F. Dempsey, General Manager

Scandinavian Airlines System (S.A.S.)

Bromma Airport, Stockholm.

Scandinavian Airlines System is the name given to the organization resulting from the unique operational coordination of the three Scandinavian air carriers, A.B. Aerotransport (Sweden), Det Norske Luftfartselskap (Norway) and Det Danske Luftfartselskab (Denmark). Before the war there had already been consultations between the Scandinavian countries with a view to establishing a jointly-operated airline to North America. However, the invasion of Norway and Denmark in 1940 thwarted these plans. Negotiations were resumed directly after the war and on August 1st, 1946, resulted in the formation of a consortium by the Danish D.D.L., the Norwegian D.N.L. and the Swedish S.I.L.A. airlines, who agreed to contribute to the operation of joint intercontinental air services in proportions amounting to two-sevenths, two-sevenths and three-sevenths for Denmark, Norway and Sweden, in that order. On July 1st, 1948, S.I.L.A. was merged with A.B.A., the Swedish Government-controlled carrier which had operated Sweden's domestic and European services. A few weeks previously, it had been decided to extend S.A.S.'s cooperation also to the competitive European services hitherto operated separately by the three carriers, so that all Scandinavian international operations are now under the S.A.S. flag. S.A.S. now operates an unduplicated network of 85,200 route miles (137,114 km), serving 69 centres in Europe, Africa, the Middle East, South and North America. Its combined air fleet totals about 70 aircraft.—In recent months S.A.S. has carried out a serious retrenchment programme in order to place its operations on a sounder footing.

Principal routes : European ; North Atlantic to New York ; South Atlantic to Buenos Aires ; Middle East ; East Africa and South Africa.

Details of S.A.S. component companies follow :

5 A.B. Aerotransport (A.B.A.)

Bromma Airport, Stockholm.

A.B. Aerotransport has just celebrated its Silver Jubilee, having been founded on March 27th, 1924. At first A.B.A. served only the principal cities in the neighbouring countries, but it soon reached out for London, Paris, Berlin and Amsterdam. At the outbreak of World War II in 1939, A.B.A. had daily connections with all the main commercial centres in Europe. When Scandinavia became a theatre of war in 1940, civil aviation was also paralyzed in neutral Sweden. The country's sole air connection with the West was the blockade-running air service maintained by A.B.A. and the Royal Air Force and, during the latter stages of the war, by U.S.A.A.F. Air Transport Command. Immediately after the end of the war in 1945, A.B.A. inaugurated services to twelve European countries ; by 1947 this had grown to 19 countries and 26 cities, apart from an extensive domestic network serving nine Swedish cities.

In 1943 a new Swedish airline, S.I.L.A., was founded to operate Sweden's inter-continental air services. This company merged with A.B.A. in July, 1948, and the resulting new A.B.A. succeeded S.I.L.A. as the Swedish partner in S.A.S. A.B.A. is 50-percent State-owned.

Per A. Norlin, President

6 Det Norske Luftfartselskap A/S (D.N.L.)

8 Fridtjof Nansens Plass, Oslo.

DNL

The first Norwegian airline, Det Norske Luftfartsrederei (D.N.L.), was established in 1918 with a privately subscribed capital of Kr. 3,300,000. This company was succeeded in 1927 by Det Norske Luftfartselskap A/S which, however, did not start operations until the Norwegian shipping lines, Fred Olsen & Co. and Det Bergenske Dampskibsselskap, had invested Kr. 1,600,000 in 1935. In that year D.D.L. obtained a ten-year concession from the Government to operate Norwegian domestic and international services. The company's activities were suppressed by the Germans during the war ; plans for the establishment of a new national airline under the same name were completed just after the war, and D.N.L. began operations in April, 1946. It was formally incorporated three months later and in March, 1947, received a twenty-year concession to operate all principal domestic and international routes in, to and from Norway. Upon the formation of S.A.S. in 1946, D.N.L. became its Norwegian partner. The Norwegian Government holds just under 20 percent of D.N.L.'s capital.

Major-General Hjalmar Riiser-Larsen,
President

7 Det Danske Luftfartselskab A/S (D.D.L.)

Raadhuspladsen 59, Copenhagen.

D.D.L. claims to be the world's oldest airline, since it was founded on October 29th, 1918, by Lieutenant Eckman and Willie Wulff, a businessman and sculptor. Its first regular routes, to Warnemunde and to Hamburg, were opened in 1920. — When the Germans occupied Denmark in 1940, all civil aviation was banned. D.D.L. was later able to reopen a route to Vienna, via Berlin, and the routes to Malmoe and Ronne. These were both very valuable during the

years when they constituted Denmark's only openings into the outer world. At the time of the German capitulation, D.D.L. had only one aircraft immediately serviceable, and the personnel consisted of about 100. Plans had been made, however, for the revitalization of the company, and the administrative manager had gone to Sweden already during the occupation, via clandestine channels, to make the necessary contacts. Shortly after the cessation of hostilities D.D.L. began to expand : In 1945 the company flew 33,000 aircraft miles (53,000 km), in 1948 222,000 miles (357,000 km). In August, 1946, D.D.L. became the Danish partner in the Scandinavian cooperation between Norway, Sweden and Denmark under the name of S.A.S. Seventeen percent of D.D.L.'s capital is held by the Government, but recently there have been suggestions that the State should subscribe new capital, bringing its participation to about 40 percent.

Per Kampmann, President

8 Aero O/Y (Finnish Airlines)

Mannerheimintie 9B, Helsinki.

Aero O/Y was founded on November 1st, 1923, and started its activities on March 20th of the following year by the inauguration of regular services between Helsinki and Tallinn. In the same year the Helsinki-Turku-Stockholm route was opened in cooperation with the newly founded Swedish A.B. Aerotransport. Other international services followed rapidly, and in 1937 the company began intensive domestic operations. During World War II aviation in Finland came under German domination, but Aero O/Y continued to share the Helsinki—Turku—Stockholm route with A.B.A. With the cessation of hostilities and in accordance with the Armistice agreement, the Company suspended its international operations. Permission to resume them was granted in November, 1947. Between 1924 and 1948, Aero O/Y increased its annual aircraft mileage from 10,520 miles (16,930 km) to 930,250 miles (1,494,410 km) and the Company is continuing to expand.—Aero O/Y represents the third attempt in Finland in the field of air transportation ; the two previous airlines, Soumen Ilmaliikenne O/Y and Lento O/Y, were founded and closed down in 1920. The line remained a completely private company until 1946, when the Finnish Government acquired control through the purchase of 70 percent of the company's stock.

Principal routes : Helsinki—Copenhagen—Amsterdam ; Helsinki—Stockholm ; Turku—Stockholm ; domestic services.

Lt.-Gen. Leonard Grandell, President

9 Koninklijke Luchtvaart Maatschappij N. V. (K.L.M.—Royal Dutch Airlines)

Raamweg, The Hague.

A number of leading personalities of Dutch commercial, banking and industrial circles on October 17th, 1919, decided to found K.L.M. Royal Dutch Airlines with a view to maintaining air services in and to the Netherlands and the overseas territories. Operations started in May of the following year, with a daily service between Amsterdam and London. By 1939 — the outbreak of World War II—nearly every European city could be reached from Amsterdam in one day ; in addition, K.L.M. had opened high-speed services to the Dutch East Indian possessions. This rapid progress was made possible first by the use of a variety of Fokker aircraft types, subsequently by K.L.M.'s introduction of the Douglas DC-2 and DC-3 transports in Europe. The outbreak of war first paralyzed a major part of K.L.M., and when the Netherlands also became involved in the hostilities, nearly the entire K.L.M. fleet was destroyed or confiscated. With a few aircraft that had escaped, the company made an attempt to maintain operations abroad and flew them under charter to B.O.A.C. between London and Lisbon. Within one year after the liberation of the Netherlands, the entirely disrupted concern was completely rebuilt, and under the agressive leadership of Dr. Albert Plesman, K.L.M., the Netherlands' national airline, had become larger than ever. Old services have been restored, new ones opened to New York, Montreal, Caracas, Buenos Aires, Johannesburg, Teheran, Shanghai, etc. K.L.M. to-day employs 13,000 people, including 1,300 aircrew, and operates to more than 100 cities.—The Netherlands Government is understood to hold a majority interest in K.L.M.

Principal routes : complete European network ; from Amsterdam to New York; Central America ; South Africa ; Indonesia ; China.

Dr. Albert Plesman, President

10 Société Anonyme Belge d'Exploitation de la Navigation Aérienne (S.A.B.E.N.A.)

145, Rue Royale, Brussels.

S.A.B.E.N.A. has been semi-Government owned since its foundation in 1923, when its initial capital of Belgian Frs. 6,000,000 was subscribed in equal proportions by Société Anonyme Belge pour l'Etude des Transports Aériens (S.N.E.T.A.) and the Belgian Government. During the first year of operations, S.A.B.E.N.A. was limited to the carriage of newspapers on the Brussels—Ostend—Lympne line. The first passenger service, Rotterdam—Brussels—Strasbourg—Basel, was inaugurated in 1924. Early in 1935 the Company started scheduled operations over its principal trunk line, the route between Belgium and the Belgian Congo. The war put a temporary stop to the activities of S.A.B.E.N.A. in Europe, but its organization in the Belgian Congo remained intact. S.A.B.E.N.A.'s aircraft and personnel were used to supply the Allied forces in Africa and maintain essential air services.

Since the end of hostilities the company has resumed and expanded its pre-war operations. Its major new post-war service, the line from Brussels to New York, was inaugurated in August, 1946.

Principal routes : services to 27 points in Europe ; to New York ; to Cairo ; to Lydda ; to the Belgian Congo ; to South-Africa ; plus a network of internal services in the Belgian Congo.

Gilbert Périer, President

11 Compagnie Belge de Transports Aériens (COBETA)

6, Rue du Midi, Brussels.

Cobeta was founded in London in 1943 by Marcel L.M. Dens, head of the Antwerp shipping firm of Armement Dens, who was in exile in London during the German occupation of Belgium. The Company opened scheduled services in July, 1947, from Brussels. There seems to be some connection with Scottish Aviation Ltd., from which Cobeta leases some of its aircraft.

Principal routes : Brussels to Haifa ; Lydda ; Manchester ; Glasgow ; Lourdes, etc.

12 Swissair—Swiss Air Transport Company Ltd.

Hirschengraben 84, Zurich.

Swissair resulted from the merger of two local airlines, Ad-Astra and Balair, on March 26th, 1931. Under the management of two of the best-known Swiss civil aviation pioneers, Walter Mittelholzer and Balz Zimmermann, the company developed rapidly. Swissair was the first company to introduce in Europe, in 1932, two Lockheed "Orion" high-speed aircraft with retractable landing gear, which was an innovation in air transportation on the European Continent. World War II interrupted the line's development, but the end of the war found the company in better economic and operational shape than most of its European competitors. Soon it resumed some of its pre-war services : Geneva—Paris on July 30th, 1945, Zurich—Paris a few days later. In 1947 the Company became the national chosen instrument carrier, its capital was increased to Sw. frs. 20,000,000, and the Government and official bodies agreed to subscribe 30 percent of the total capitalization. Since that date Swissair has pursued its cautious expansion programme and has acquired new equipment for its European routes and the service to New York ; it is expected to buy large new aircraft for its projected route expansion in the near future.

Principal routes : from Basle, Berne, Geneva and Zurich to sixteen capitals and seven other cities in Europe and the Middle East ; to New York.

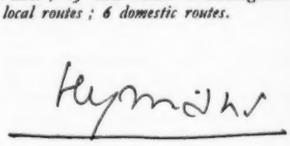
Dr. Rudolf Speich, Chairman

13 Compagnie Nationale Air France (Air France)

2, Rue Marbeuf, Paris, VIII^e.

The history of Air France can be divided into four stages : 1918 to 1933 : This was the pioneering period in which a number of Air France predecessor companies established air services to points in Western and Eastern Europe, to the Middle and Far East and South America. 1933-1939 : The beginning of this stage was marked by the formation of Air France through the consolidation of six predecessor airlines. It was a period of expansion and experimentation and also witnessed the development of other lines which finally became absorbed in Air France : Régie Air Afrique, Régie Malgache, Compagnie Air Bleu, Compagnie Aéromaritime, and Air France Transatlantique, the last-named of which made twelve North Atlantic proving flights before the outbreak of war. 1939-1945 : Upon the outbreak of war, Air France's personnel and equipment was placed at the disposal of the Government. After the Franco-German armistice, from 1940 to 1942, several regular services were flown between unoccupied France and points in North and West Africa. In 1942, personnel and equipment that had escaped the Germans were reorganized in North Africa and operated three networks of military routes known as "Lignes Aériennes Militaires" (L.A.M.). Directly after the Liberation, the remnants of Air France's personnel and equipment at home were formed into a fourth military network, and early in 1945 the four systems (Metropolitan France, North Africa, Central Africa, and Near East) were placed under a centralized command, the "Réseau des Lignes Aériennes Françaises," which in effect constituted the nucleus of the new Air France. 1946-1949 : In January, 1946, the name of Air France was officially re-established. On June 16th, 1948, the provisional status of Air France was abolished and replaced by law with its present constitution as Compagnie Nationale Air France, the French Government's (85-percent owned) "chosen instrument" air carrier.

Principal routes : 9 intercontinental routes to North and South America, West Africa, Madagascar, Pakistan, India, India and China ; 17 European routes from Paris and other French cities to 16 centres ; 23 Mediterranean routes ; 9 Central African ; 3 Central American local routes ; 13 local routes in Madagascar ; 11 Far Eastern local routes ; 6 domestic routes.



Dr. Max Hymans, Chairman

14 Iberia - Compania Mercantil de Lineas Aereas Espanolas S. A.

Plaza de Canovas del Castillo 4, Madrid.

The new Iberia is the indirect successor to three Spanish air carriers established in 1921-22, namely, Iberia Compania Aerea de Transportes, Compania Espanola de Trafico Aereo, and Union Aerea Espanola. In 1929 the three were amalgamated into a new company, subsidized by the Spanish Government and backed by Spanish private finance and industry : Cia Concesionaria de Lineas Aereas Subvencionadas S.A. (C.L.A.S.S.A.). This organization was in turn succeeded in 1932 by a State-controlled commercial organization, Lineas Aereas Postales Espanolas (L.A.P.E.). When the Civil War broke out in Spain in 1936, L.A.P.E. remained in the hands of the Republicans and its services became disrupted. The Falangists, on the other hand, organized air services in their own territory with German assistance, and Sociedad Espanola Iberia was established in 1937 to carry on air transport operations. However, when the Civil War ended in 1939, Spanish civil aviation had ceased to exist. In order to relieve pressure on the remaining meagre surface transport, the Government in April, 1940, set up a temporary Commission (Trafico Aereo Espanol) to operate civil air services. A few months later the new Iberia was formed to take over the assets of the old L.A.P.E. and the wartime Iberia. Capitalization was Ptas. 12,000,000, 51% of which was held by the Government, 24.5% by Spanish private individuals and 24.5% by Deutsche Lufthansa (against the supply of equipment, etc.). The two minority holdings were acquired by the Instituto Nacional de Industria in 1941, and in 1944 I.N.I. took over the entire increased capitalization of Ptas. 90,000,000. I.N.I. is authorized to sell up to 25% of the total stock to Spanish shipping interests.

Principal routes : from Madrid to London ; Paris ; Rome ; Lisbon ; Puerto Rico ; Buenos Aires ; domestic services ; etc.

Jesus Rubio Paz, Chairman

15 Transportes Aereos Portugueses (T.A.P.)

Rua Braancamp 2, Lisboa.

The Portuguese Government established Transportes Aereos Portugueses in the middle of 1944 as a Division of the Secretariat of Civil Aviation. The Division operated experimentally until September, 1946, when regular schedules were inaugurated. T.A.P.'s initial object was to undertake proving and survey flights on new routes which subsequently were to be transferred to commercial airlines for scheduled operation. No route transfers have so far taken place, however. T.A.P.'s most important operation is that connecting the mother country with the capitals of the two African colonies, Luanda in Angola and Lourenco Marques in Mozambique. The line is planning several new services and extensions, including one from Luanda to Johannesburg, South Africa.

Principal routes : Lisbon—Luanda—Lourenco Marques ; Lisbon—London ; Lisbon—Paris ; Lisbon—Madrid.

Col. Carlos M. Magalhaes, General Manager

16 Aero Portuguesa Lda. (Aero-Portugueral)

Avenida da Liberdade 120, Lisboa.

Aero Portuesa Lda. was organized in 1934 as a subsidiary of Air France. Its main object was the establishment of a route from Lisbon to Casablanca, connecting there with Air France's South Atlantic air mail service. Operations started in October, 1934, and continued until the outbreak of war, when the line had to be terminated at Tangiers. In 1943 the Portuguese Government issued a requirement that at least 62.5 percent of the Company's capital be held by Portuguese interests, whereupon Air France sold half of its 75 percent holding to Companhia Nacional de Navegacao, the shipping concern, bringing the Portuguese holding to the required figures. In 1946 the Company opened unsuccessful negotiations for a service to Paris, and at present Aero Portuguesa awaits the formulation of a policy by Prime Minister Salazar regarding the designation of a colonial or international air carrier.

Principal route : Lisbon—Tangier.

17 *Companhia de Transportes Aereos (C.T.A.)

Avenida da Liberdade 23-27, Lisbon.

C.T.A. was founded by private interests in 1945 and operatd a scheduled service between Lisbon and Oporto until July, 1947, when the route was taken over by Transportes Aereos Portugueses. C.T.A. is now believed to be operating on a non-scheduled or charter basis and therefore is no doubt the only such air carrier to be affiliated with I.A.T.A.

18 Alitalia - Aerolinee Italiane Internazionali

Via L. Bissolati, 20, Rome.

Alitalia was established in September of 1946, under an agreement between the Government-owned Institute per la Ricostruzione Industriale and the British Overseas Airways Corporation. The initial capital of Lire 900,000,000 was held to the extent of 40% each by B.O.A.C. and I.R.I., whereas 20% was left to Italian private industry. In 1948 it was proposed to increase the capital to Lire 2,500,000,000, but the plan failed due to opposition by the British Treasury.

The capitalization was raised to Lire 1,500,000,000, however, with the proportions of ownership remaining unchanged ; B.O.A.C. has meanwhile been succeeded by British European Airways Corp. as the British stockholder in the company. Alitalia was the first and only Italian airline to resume operations to South America when, in May, 1948, it opened its service to Buenos Aires. At the present time the company is preparing new routes to South Africa, Kenya, to the Near and Far East and to Northern Europe.

Principal routes : from Rome to Natal, Rio de Janeiro, Sao Paulo, Montevideo and Buenos Aires ; from Rome to Cairo and Asmara ; to Paris ; to London ; to Geneva ; etc.

Count Nicolo Carandini, Chairman

19 A.L.I. Flotte Riunite

76, Via L. Bissolati, Rome.

A.L.I. Flotte Riunite's predecessor, Avio Linee Italiane, was established in November, 1926. The original capital of Lire 12,000,000 was subscribed by the Fiat industrial concern, Standard Oil interests and the Government. The Company opened its post-war operations in 1946 and gradually extended its services. The highly competitive situation in Italian air transport made the desirability of consolidation increasingly evident, and negotiations to this end were started with several other Italian carriers in 1948. Last July these led to the formation of A.L.I. Flotte Riunite through the merger of Avio Linee Italiane with Aerone, S.I.S.A. and Transadriatica, as the first stage of a vast consolidation plan. A majority interest in the new company continues to be held by Fiat. The next step in the Government-supported consolidation programme will be the merger of A.L.I. Flotte Riunite with the Government-owned but practically inoperative L.A.T.I. transcontinental airline. The final aim of the project is the formation of a new Italian national airline, with a capitalization of about Lire 2,000,000,000, which will safeguard Italy's civil aviation interests together with the Italo-American L.A.I. and the Italo-British Alitalia.

Principal routes : Rome to Paris ; Beirut ; Milan to Vienna, Prague, Budapest, Copenhagen, Nice, Brussels ; domestic services.

20 Greek Airlines (T.A.E.) - Technical & Aeronautical Exploitation Co. Ltd. TAE

12, Merlin Street, Athens.

Greek Airlines (T.A.E.), the first post-war Greek airline, was originally established in 1940—before the German occupation—as an air charter and taxi company by Colonel Stephen A. Zotos, present Managing Director. Its equipment and installations were destroyed during the German invasion. In 1946 Greek Airlines signed a contract with Trans World Airline, under which T.W.A. subscribed 35 percent of the Company's new, privately-owned capital and provided it with technical assistance. Greek Airlines is one of the most intensively operated small carriers : in 1948 it flew 185,875 passengers on 23 routes. The company is planning new services to Istanbul, Rome and Paris.

Principal routes : Athens—Alexandria ; 22 domestic routes.

Col. Stephen A. Zotos, Managing Director

21 Hellenic Airlines S. A. ("Hellas")

St. George Karyoti Square, Athens.

"Hellas" is the result of an agreement signed in November, 1947, between Scottish Aviation Ltd., British charter company, maintenance and manufacturing organization, and the Pension Funds of the Greek Army, Navy, Air Force and Civil Service. The agreement provided for the establishment of an airline operating Greek internal and overseas air services, the intention being that "Hellas" should become the Greek "chosen instrument" airline. Scottish Aviation furnished 40 percent of the capital as well as technical assistance and leased the necessary equipment to "Hellas." In addition to its present routes, "Hellas" is planning services to Cyprus and points in Italy, Switzerland and France, apart from Paris.

Principal routes : Prestwick—London—Paris—Athens—Nicosia—Lydda ; Athens to Paris and Glasgow ; to Alexandria ; domestic services to about 10 stations.

J. Sakellion, President

22 Ceskoslovenske Aerolinie (C.S.A.) - Czechoslovak Airlines

1 Namestie Republiky, Prague.

Ceskoslovenske Aerolinie celebrated its 25th anniversary on March 1st, 1948. It was in 1923 that an aircraft of its predecessor airline, Ceskoslovenske Statni Aerolinie (C.S.A.), made the first flight from Prague to Bratislava. The old C.S.A. successfully competed with a second Czech line, Ceskoslovenske Letecka Spolecnost (C.L.S.), founded in 1927, for its position as Czech flag air carrier. Both companies ceased operations after the German occupation in March, 1939. After the end of the war in 1945, the two airlines were merged into the present C.S.A. which is a direct State enterprise within the Civil Aviation Department of the Ministry of Transport. Plans have been worked out to reorganize C.S.A. as a corporation similar to the State corporations set up in other branches of national economy.—C.S.A.'s expansion plans were severely handicapped following the Communist seizure of power early in 1948. The Company had been negotiating for a number of Lockheed "Constellations," Douglas DC-4s, or "Canadair-Fours," but the suppliers refused to sign a contract as a result of the political events in Prague. C.S.A. thereupon turned to the U.S.S.R., which meanwhile has delivered four Ilyushin IL-12 twin-engined airliners and promised delivery of several Ilyushin IL-18 four-engined aircraft. C.S.A.'s plans include services to India, South Africa, etc.

Principal routes : Prague to Budapest, Belgrade, Sofia, Bucharest ; Rome, Athens, Lydda, Istanbul, Zurich, Paris, London, Copenhagen, Stockholm, Oslo, Berlin, Warsaw, etc ; domestic services.

23 Polskie Linie Lotnicze (L.O.T.)

Rue Hoza 39, Warsaw.

L.O.T. was another result of the tendency in the 'Twenties to consolidate smaller airlines into single national flag carriers. The Company was founded on January 1st, 1929, by the amalgamation of two private Polish lines, Aerolat and Aero ; its initial capital of Zl. 8,000,000 was held by the Finance Ministry and other public bodies. L.O.T. was one of the first European companies to put the Douglas DC-2 and Lockheed 14 transports into service.—L.O.T. resumed its services under a decree of March 6th, 1945, which placed the concern under direct State control. Its flying equipment consists of five French-built "Languedoc" airliners, about 26 Li-2 transports (Russian-built DC-3s) and a few Douglas DC-3s. Suggestions have recently been put forth that L.O.T. should emulate the Czech example and purchase Russian Ilyushin IL-12 transports to modernize its fleet.

Principal routes : Warsaw to Stockholm, Copenhagen, Berlin, Paris, Brussels, Prague, Budapest, Belgrade, Sofia, Bucharest ; domestic services.

24 Pan American Airways, Inc. (P.A.A.)

135 East 42nd St., New York 17, N.Y.

Pan American Airways will be 22 years of age on October 19th, 1949. Although younger than many other world-wide airline systems, it is the largest international air carrier in the world to-day. It made its first flight on October 19th, 1927, carrying a 500-lb. load of international mail over the 90-mile stretch from Key West, Florida, to Havana, and throughout its subsequent history it has engaged only in international operations. The company was a result of the amalgamation of three small lines, Aviation Corporation of the Americas, Florida Airways and Pan American Airways Inc. In the first years of its existence it concentrated on the establishment of air services to points in Central and South America. Soon the management discovered that it was to its advantage in certain parts of the world to operate through so-called "national affiliates," *i. e.*, companies which are nominally registered in the countries of their domicile but are financially or operationally controlled or "inspired" by P.A.A. At the present time P.A.A. possesses interests in the following major airlines : Panair do Brasil, Aerovias Nacionales de Colombia (A.V.I.A.N.C.A.), Compania Mexicana de Aviacion, Compania Cubana de Aviacion, China National Aviation Corporation ; it also holds a 50% interest in Pan American-Grace Airways, which operates services along the west coast of South America. Investments in smaller companies include Aeronaves de Mexico, Aerovias Venezolanas S.A., Bahamas Airways, Compania Dominicana de Aviacion, Compania Panamena de Aviacion, Lineas Aereas de Nicaragua, Servicio Aereo de Honduras, Lineas Aereas Costaricenses.

In 1935 P.A.A. opened trans-Pacific passenger services to Hong Kong ; a route to New Zealand was added in 1940. P.A.A. had extended its activities to the North Atlantic already in 1938 and since the end of the War it has expanded its East-bound operations as far as Calcutta. There it linked up with its Pacific services, and P.A.A. thus became the first airline to establish round-the-world services (excepting the continental U.S.A.).

During World War II P.A.A.'s network of air routes was controlled by the U.S. Government but the Company continued to operate under contract to the authorities.

Another outstanding characteristic of P.A.A. is the fact that even in times of serious financial difficulties in the airline industry, it has consistently succeeded in making money.

At the present time P.A.A. is negotiating for the acquisition of American Overseas Airlines. Its plans are now being discussed by the Civil Aeronautics Board in Washington, and if they are approved will enhance P.A.A.'s supremacy in the trans-Atlantic air transport field, extending from North America to the United Kingdom, Scandinavia, Central Europe, the Mediterranean and eastwards.

Principal routes : Atlantic : to London, Central Europe, Middle East and Karachi, Calcutta, linking with Pacific services. New York to Lisbon, Madrid ; to Dakar and Johannesburg.
Latin America : complete network to Central and South America.
Pacific : Seattle, San Francisco and Los Angeles to Honolulu, New Zealand and Australia ; to Tokyo, Hong Kong, Philippines, Siam and Batavia, etc.

Juan Terry Trippe, President

25 Pan American-Grace Airways, Inc. (Panagra)

135 East 42nd Street, New York 17, N.Y.

Panagra's predecessor was formed on September 13th, 1928, by Pan American Airways and W.R. Grace & Co., the U.S. shipping concern ; P.A.A. and Grace jointly bought up Huff-Daland, Inc., a general airwork company, and renamed it Peruvian Airways Corp. Operations started almost at once under a Peruvian Government air transport concession. The company's name was changed to Pan American-Grace Airways early in 1929, and within one year Panagra had extended its services to Santiago, Buenos Aires and Montevideo. To-day Panagra forms an important link in the network of airlines operated by Pan American Airways.—During the war Panagra worked under contract to U.S.A.A.F. Air Transport Command and was instrumental in ousting German-held interests from civil aviation in several South American countries.—Relations between Panagra's owners have not always been rosy. In 1943 both P.A.A. and Grace declared before the C.A.B. that the other party was deliberately "retarding" the progress of the Company in order to obtain full control. These difficulties seem to have been partly overcome in the meantime, however. — From 1939 to recently, Harold J. Roig has been Panagra's President. Last July he was succeeeded by Andrew B. Shea, Director and Senior Vice-President of W. R. Grace & Co. Douglas Campbell is General Manager.

Principal routes : Miami—Balboa—Guayaquil—Lima—Santiago—Buenos Aires—Montevideo ; local services in and to eight South American countries, mostly on the Pacific coast.

Andrew B. Shea, President

26 American Airlines, Inc (A.A.)

100 East 42nd St., New York 17, N.Y.

American Airways, Inc., was formed on January 25th, 1930, by the consolidation of Colonial Airways, Universal Aviation Corp., Southern Air Transport System, Interstate Airlines, Thompson Aeronautical Corp., Embry-Riddle Co., Frank Mortz Airlines, Century Airlines and Century Pacific Air Lines. The Company was reorganized after the air mail contract cancellations of 1934 and renamed American Airlines. Highlights in the evolution of American Airlines were the inauguration of the first sleeper aircraft service in 1934 and the introduction of the Douglas DC-2 in the same year. In 1935 A.A. developed an airways traffic control system which was later adopted by all airlines and administered by the Civil Aeronautics Administration. In collaboration with Radio Corporation of America, A.A. pioneered the development of U.H.F. radio for two-way communications. After America's entry into the war the company turned over 38 of its 84 aircraft to the Army Air Forces. Throughout the war American Airlines also conducted contract flights, training and engineering operations for the Allied forces. Immediately after the cessation of hostilities in Europe, in July, 1945, American bought a majority interest in American Export Airlines, which was renamed American Overseas Airlines. At the present time American is negotiating for the sale of A.O.A. to Pan American Airways.—A.A. currently holds at least two all-time U.S. air transport industry records : in May, 1949, it completed more than 4,500,000,000 passenger-miles of flying without fatality to a passenger ; furthermore, in June, 1949, it established a record for revenue passenger-miles flown in any single month by one airline by flying 156,009,534 passenger-miles.

Principal routes : American Airlines operates the largest network of U.S. domestic services, including transcontinental services from East Coast cities (Boston, New York, Philadelphia, Washington) Chicago and Detroit, to San Francisco and Los Angeles. It also flies to Canada in the north and Mexico City in the south.

C. R. Smith,
President of A.A. and A.O.A.

27 American Overseas Airlines (A.O.A.)

100, East 42nd St., New York 17. N.Y.

American Overseas Airlines is the successor to American Export Airlines which was incorporated in 1937 as a subsidiary of American Export Lines, the shipping firm, to operate trans-Atlantic air services in conjunction with the parent company's steamship operations. American Export Airlines started operations in 1942. The Civil Aeronautics Board subsequently ordered the airline to divest itself of steamship control, and on July 5th, 1945, the Board approved the purchase of a majority interest in A.E.A. by American Airlines and, thus, the integration of A.E.A.'s trans-Atlantic services with the domestic services of A.A. In November of the same year A.E.A. changed its name to American Overseas Airlines. In December, 1945, it began its daily trans-Atlantic air service, and the intervening years have seen the initiation of services on all authorized routes with the exception of the sectors extending into Poland and Russia. A highlight

of A.O.A.'s history is its participation in the Berlin Air Lift as the only scheduled commercial airline to fly its services over the route from Frankfurt to Berlin throughout the period of the Russian blockade. If an application now before the Civil Aeronautics Board in Washington is granted, American Overseas Airlines will be taken over by Pan American Airways later this year.

Principal routes : A.O.A. links Washington, Philadelphia, New York and Boston in the U.S.A. with Greenland, Iceland, Eire, Scotland, England, The Netherlands, Germany, Denmark, Norway, Sweden and Finland.

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28 Transcontinental and Western Air, Inc. (T.W.A.) - Trans World Airline

630 Fifth Avenue, New York 20, N.Y. 101 West 11th, St. Kansas City 6, Mo.

Transcontinental & Western Air, Inc., which is now observing the 20th anniversary of its first U.S. transcontinental air-rail passenger service, grew out of one-plane operation Aero-Corporation of California, which was started in 1926 by the T.W.A.'s well-known former President, Jack Frye. The Company developed into Standard Air Lines which, in the autumn of 1930, was merged with Western Air Express, Maddux Airlines and Transcontinental Air Transport (T-A-T) to form Transcontinental & Western Air. Howard R. Hughes, the multi-millionnaire manufacturer and sportsman pilot, became T.W.A.'s principal stockholder in 1939 and today holds a majority of T.W.A. stock. Following the establisment of a dense network of U.S. domestic transcontinental air services, T.W.A. operated international services for the U.S. Army Forces during the war and branched out into commercial overseas operations after the end of hostilities. On February 5th, 1946, the airline inaugurated its first service to Europe, and a short time later expanded its operations to North Africa, the Middle East, to Bombay and Calcutta. Today the Company services 53 stations within the U.S.A. and 17 stations abroad. Jack Frye, the original organizer of T.W.A.'s predecessor company, was President until 1947. Since January, 1949, Ralph S. Damon has been T.W.A.'s top executive.

Principal routes : U.S. transcontinental from New York, Philadelphia, Chicago, Kansas City, to San Francisco and Los Angeles ; trans-Atlantic from New York to Shannon, Paris, Geneva, Zurich, Lisbon, Madrid, Rome and beyond to Cairo, Dhahran, Bombay, Colombo and Calcutta.

Ralph S. Damon, President

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29 United Air Lines (U.A.L.)

5959 South Cicero Avenue, Clearing Station, Chicago 38, Ill.

U.A.L.'s first two predecessor companies, Varney Air Lines and Pacific Air Transport, began services in the western part of the U.S.A. in 1926. In 1927, Boeing Air Transport and National Air Transport, the other two predecessors, started operations between San Francisco and Chicago, on the one hand, and Chicago and New York on the other. The four companies were merged to form United Air Lines in 1931. Upon America's entry into World War II, half of U.A.L.'s fleet of twin-engined transports were turned over to the U.S. Army Air Forces. During the next three years, U.A.L. crews flew for the Air Transport Command across the Pacific as well as between the U.S.A. and Alaska. After the war, the Company was granted a certificate to operate services between San Franciso and Honolulu.

United's wartime activities included the modification of 5,736 military aircraft and the training of hundreds of military ground and flight personnel. "Firsts" introduced by United and its predecessors were the employment of air hostesses in 1930, the adoption of all-metal low-wing twin-engined transports (the Boeing 247) in 1934, first tests of instrument landing procedures in 1932.

In 1948, U.A.L. flew its 10,000,000th passenger, its 500,000,000th aircraft-mile and its 5,000,000,000th revenue passenger-mile.

Principal routes : transcontinental, from Boston, New York, Washington and Chicago to San Francisco and Los Angeles ; American West Coast from Vancouver to Seattle, San Francisco, Los Angeles and San Diego ; San Francisco—Honolulu. Routes of L.A.M.S.A., United's Mexican subsidiary, extend 2,000 miles from the U.S.-Mexican border to Mexico City.

W. A. Patterson, President

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30 Eastern Air Lines (E.A.L.)

Eastern Air Lines Building, 10 Rockefeller Plaza, New York 20, N.Y.

Eastern Air Lines, the fourth-largest U.S. domestic airline, in 1934 succeeded Pitcairn Aviation Inc. ; the latter had been formed in 1928 for the carriage of mail between New York and Atlanta. Originally, Eastern was a division of North American Aviation, Inc., the manufacturing firm which in turn was controlled by General Motors Corp. In 1938 Captain Edward Vernon Rickenbacker, America's World War I air ace, and a number of associates, bought the line from General Motors for $3,500,000 and changed its name to Eastern Air Lines, Inc.

The most characteristic feature of E.A.L. has been the fact that—like P.A.A., but primarily in the domestic field—it has been making money even during the years in which other lines incurred heavy losses.—To finance his conservative equipment programme, Rickenbacker obtained at the end of 1946 a five-year loan of $20,000,000 from 27 banks at an interest rate of only 1 ½ percent ; $16,000,000 of the loan has so far been used. — E.A.L. did not engage in any large-scale foreign route expansion programme directly after the war, but its present plans are fairly extensive : apart from its ambition to become the fifth U.S. transcontinental operator by inaugurating the Southern Transcontinental Route from Miami to New Orleans, San Antonio (Tex.), El Paso, San Diego, Los Angeles and San Francisco, it has applied to the C.A.B. for permission to operate non-stop services from New York and Washington to Puerto Rico. It has also asked for authorization to open new services to about 35 stations in the northeast of the U.S.A. and Canada.

Principal routes : New York—Washington—New Orleans—Mexico City ; Miami—San Juan (P.R.) ; a vast network of domestic routes in the eastern U.S.A. linking about 80 stations.

Capt. Edward V. Rickenbacher, President and General Manager

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31 Northwest Airlines, Inc.

1885 University Avenue, St. Paul, Minnesota.

Northwest Airlines' predecessor company, Northwest Airways, began operations in the autumn of 1926 with a regular air mail service between the Twin Cities (Minneapolis and St. Paul) and Chicago. In 1927 the company inaugurated passenger services and also extended its operations across the border to Winnipeg, Canada. In 1941 the company applied for permission to fly to Alaska, but America entered the war shortly afterwards and no civil air route was opened. On the other hand, Northwest personnel was hired by the Air Force with a view to establishing a military air supply line for the U.S. forces fighting the Japanese in the Aleutians. Later in the war the company operated bomber modification centres at St. Paul and Vandalia, and ran several Army and Air Force training schools. Directly after the end of the war in Europe, Northwest opened services from the Twin Cities to New York and thus became the fourth U.S. transcontinental operator. Meanwhile, Northwest had made preparations to branch out into the international air transport field, and in the middle of 1947 it began operations to Tokyo, Shanghai, and Manila. Since then, the Company has further expanded its network and started a service to Honolulu, Hawaii, last December.

Principal routes : transcontinental from New York to Seattle ; Seattle—Honolulu ; North Pacific service from New York to Alaska, the Aleutians, Japan, Korea, China and the Philippines.

Croil Hunter, President and General Manager

32 Braniff Airways, Inc.

Love Field, Dallas, Texas.

Thomas Braniff formed his first Braniff Airways in 1928 to operate services in Oklahoma, Kansas and Missouri ; he lost money and the following year sold out to another line. In 1930 Braniff saw the possibility of obtaining U.S. mail contracts and registered Braniff Airways Inc. for services in the Oklahoma—Kansas—Texas area. Although the Company did not receive the contracts it had expected, it expanded steadily. The fact that during the war it operated services to the Panama Canal Zone under contract to the U.S. Army seems to have given it a taste for international operations. It set up a Mexican subsidiary, Aerovias Braniff S.A., which to-day has a capital of 20,000,000 Pesos (51 percent owned by Mexican interests, 49 % by Thomas E. Braniff ; in 1946 C.A.B. rejected a Braniff Airways application to re-acquire control of its former subsidiary). In 1946 the C.A.B. granted Braniff permission to fly more than 7,000 route-miles of services from Houston, Tex., along the South American Pacific Coast to Quito, Gauyaquil and across the Andes to Rio and Buenos Aires. Following difficult negotiations with the South American authorities, Braniff inaugurated the service last year and now operates as far as Rio. The Company has applied to the C.A.B. for permission to fly south to Santiago de Chile and north to Washington and New York.

Principal routes : Houston—Havana—Balboa—Guayaquil—Lima—La Paz—Rio de Janeiro ; domestic services in the central U.S. and Texas.

Thomas E. Braniff, President

33 Trans-Canada Air Lines (T.C.A.)

360, McGill Street, Montreal, Quebec, Canada.

Trans-Canada Air Lines was incorporated by Act of Parliament on April 10th, 1937, as an autonomous Government-owned corporation. The Canadian National Railways, itself an autonomous public-owned corporation, holds the capital stock of T.C.A. In September, 1937, operations were started between Winnipeg and Vancouver, and on April 1st, 1939, the first transcontinental passenger flight between Montreal and Vancouver was started. Domestic route expansions continued throughout the years until a route pattern linking all major Canadian cities and eight cities of the United States was completed. In 1942 the Company undertook to operate a trans-Atlantic service for the Government carrying mail for Canadian troops abroad, and T.C.A. entered the trans-Atlantic civil aviation field in April, 1947, when the war-inspired Government trans-Atlantic service ceased to exist. In 1948 T.C.A. started services between Canada and Bermuda as well as British points in the Caribbean.

Principal routes : transcontinental, trans-Atlantic to England and Scotland, Toronto—Jamaica, Toronto and Montreal to Bermuda and Trinidad.

G. R. McGregor, President

34 Canadian Pacific Air Lines Ltd. (C.P.A.)

Windsor Station, Montreal, Quebec.

Canadian Pacific Air Lines was formed in 1942 through the merger of ten smaller regular air carriers and bush operators. The Company integrated the services run by the various lines into a close-knit route network and soon began to go farther afield. Early in 1944 it announced that it was preparing a regular air service across the North Atlantic. A few months later, however, the Canadian Government declared that its own "chosen instrument," Trans-Canadair Air Lines, would be solely responsible for carrying out international and domestic trunk services, and that Canadian Pacific Railways would have to divest itself of the ownership of its airline interest. However, no order to this effect was ever issued, and the Canadian Government even authorized C.P.A. to operate the Pacific services which it was scheduled to inaugurate this summer. —C.P.A. made a major contribution to the war, namely, the ferrying of bombers across the Atlantic. The Company controlled this service for thirteen months before it was taken over by R.A.F. Ferry Command. It also participated successfully in the British Commonwealth Air Training Plan, and under this scheme it operated six air observer schools on a non-profit basis.

Principal routes : trans-Pacific from Vancouver to San Francisco, Honolulu and Sydney and Vancouver to Anchorage, Shemya, Tokyo, Shanghai and Hong Kong ; domestic services operated in Canada on a general north-to-south basis.

Grant W. G. McConachie, President

Latin American Airlines

35 Aerolineas Argentinas — F.A.M.A.

Lavalle 648, Buenos Aires.

Flota Aerea Mercante Argentina (F.A.M.A.) was established in February, 1946, under a decree issued on December 31st, 1945, as a partly privately and partly Government-owned corporation Private shareholders subscribed $^2/_3$ of the capital, the Government the rest. F.A.M.A. inaugurated its operations on June 4th of the same year with a flight to London and rapidly extended its network in the following twelve months. However, the Company was soon found to be incurring disastrous losses, as did the other three semi-State controlled Argentine airlines founded at the same time (A.L.F.A., Z.O.N.D.A. and Aeroposta), and on May 3rd, 1949, the Argentine President issued a decree nationalizing the four companies. On June 14th the ensuing reorganization was completed, F.A.M.A. was renamed Aerolineas Argentinas F.A.M.A., and the new Government-appointed Director-General assumed his functions.

Principal routes : Buenos Aires to Rio de Janeiro, Natal, Dakar, Lisbon, Madrid, Rome, Paris, London ; to Sao Paulo ; to Santiago de Chile.

Fermin José Donzelli, Director-General

36 Linea Aerea Nacional (L.A.N.)

Los Cerillos, Santiago de Chile.

L.A.N. inaugurated its existence on March 5th, 1929' under the name of Linea Aero-Postal Santiago-Arica and was under the direct control of the Air Force High Command until the middle of 1932. In that year it was given autonomous legal status, renamed Linea Aerea Nacional and given an air transport monopoly for the territory of Chile. Highlights in the Company's development were the opening of a service to Magallanes, Chile's southernmost city, in 1946, and, in the same year, the inauguration of L.A.N.'s only international service, that to Buenos Aires. L.A.N.'s operations have distinguished themselves by their high safety factor, and in 1942, 1944, 1945 and 1946 the Company was awarded the Air Safety Award of the Inter-American Safety Council.—L.A.N. continues to be owned by the Chilean Government. Its Administrative Council and General Manager (Executive Vice-President) are appointed by the President of the Republic.

Principal routes : Santiago to Buenos Aires ; Magallanes, Punta Arenas ; Valparaiso ; Arica ; etc.

Juan del Villar Araya,
Executive Vice-President

37 Panair do Brasil (Panair)

Avenida Rio Branco 85, Rio de Janeiro.

Panair do Brasil is the successor to the Brazilian subsidiary of the American company N.Y.R.B.A. (New York—Rio—Buenos Aires Line), N.Y.R.B.A. DO BRASIL, which was formed in 1929. Pan American Airways in 1930 bought up N.Y.R.B.A. and N.Y.R.B.A. do Brasil and changed the latter's name to PANAIR DO BRASIL. For many years Panair do Brasil was practically 100 % owned by Pan American, but by the end of 1944 P.A.A.'s interest had been reduced to 58 % and large proportions of succeeding stock issues were acquired by Brazilian nationals. As a result, Panair is now 52 % Brazilian-owned. Panair do Brasil started its operations on November 28th, 1930, when it inaugurated an air mail service between Belem and Santos. The first international operation was inaugurated a year later with the extension of the line to Buenos Aires. During the war Panair's operations expanded considerably in connection with Brazil's growing war effort, one of its most notable achievements being its active cooperation with the Rubber Development Corporation in the Amazon valley. Following the end of hostilities in Europe, Panair began to prepare its overseas operations. The Company received its first Lockheed "Constellation" in March, 1946, and by the end of 1947 Panair connected Brazil with French West Africa, Portugal, France, England, Italy, Egypt and Turkey.

Principal routes : Rio de Janeiro to Montevideo ; to Buenos Aires ; to Lisbon—Paris—London ; to Lisbon—Madrid—Zurich ; Madrid—Rome—Istanbul ; Paris—Stuttgart ; plus a considerable network of domestic routes.

Dr. Paulo de Oliveira Sampaio, President

38 Servicos Aereos Cruzeiro do Sul, Ltda.

Avenida Rio Branco 128, Rio de Janeiro.

Following a series of proving flights in 1926, the Sindicato Condor Ltda. was formed on December 1st, 1927, with substantial German assistance. In 1941 the German interests were partly eliminated and the Company was renamed Servicos Aereos Condor Ltda. Finally, in 1943, Condor was completely reorganized, renamed Servicos Aereos Cruzeiro do Sul, and all German influence eliminated. To-day the Company is completely privately-owned without foreign participation. In 1949 it expects to fly about 6,850,000 aircraft-miles.

Principal routes : A large network of services along the Brazilian coast and in the interior ; services from Rio de Janeiro to Buenos Aires ; routes to Montevideo, Santiago de Chile, Caracas and New York are planned.

Dr. José Bente Ribeiro Dantas, President

39 S. A. Empresa de Viacao Aerea Rio Grandense (V.A.R.I.G.)

Avenida Borges de Medeiros 445, Porto Alegre, Brazil.

V.A.R.I.G. is the oldest formally organized airline in Brazil. It was formed on May 7th, 1927, by private citizens of the State of Rio Grande do Sul, with the assistance of German interests connected with what later became the Condor Syndicate (now Servicos Aereos Cruzeiro do Sul). In 1932 the State of Rio Grande do Sul acquired 21 percent of the V.A.R.I.G. stock, and in 1941 the Brazilian Government brought about another reorganization to oust the concealed German influence. In the middle of 1946 V.A.R.I.G. doubled its capital to Cr. 2,000,000, and present ownership includes 25 percent interest held by the State of Rio Grande do Sul, 10 percent by the Federal Government and municipalities, and 65 by private residents of the State of Rio Grande do Sul. V.A.R.I.G.'s operations were largely confined to this state until 1946—with exception of the Montevideo route opened in 1949—when the Company started several inter-state services.

Principal routes : Rio de Janeiro to Montevideo ; from Porto Alegre to about 25 domestic stations.

40 Aerovias Nacionales de Colombia (AVIANCA)

Carrera 9, Calle 12, Bogota.

Avianca's principal predecessor company, Sociedad Colombo-Alemana de Transportes Aereos (Scadta), organized at the end of 1919 by German aviation pioneers (Dr. Peter Paul v. Bauer, von Krohn, etc.) is described as "America's oldest airline." In 1931 Pan American Airways acquired an 80 percent interest in Scadta. The Colombian Government in 1939 decided to merge Scadta with Servicio Aereo Colombiano (Saco) in order to form Avianca, and the merger was approved in 1940. Of the present capital, P.A.A. holds 48 percent, whereas 10 percent is still owned by P. P. von Bauer, now a naturalized Colombian citizen. Avianca seems to have overcome a series of immediate post-war difficulties (equipment and labour trouble) and in addition to a vast interior has started a cautious overseas operating programme. The first major route of this programme is that to the United States, which eventually is to be followed by services to Europe via the mid-Atlantic.

Principal routes : Bogota to Miami and New York ; to Panama ; Quito ; internal services (65 cities).

Dr. Jorge Restrepo Hoyos, President and General Manager

41 Linea Aeropostal Venezolana (L.A.V.)

Bloque No. 1, El Silencio, Caracas.

The establishment of Linea Aeropostal Venezolana took place in 1933 when the Venezuelan Government decided to nationalize the Venezuelan branch of Aeropostale, pioneer French air carrier. It operated directly under the Ministry of Labour and Communications until 1937, when it was made an autonomous Government-owned concern. In October, 1945, L.A.V. was placed under the Office of Transportation in the new Ministry of Communications. Finally, in 1947 the Government issued a decree regulating L.A.V.'s administration and activities in considerable detail and bringing its capitalization to the present level. In 1946 the Company opened regular services to New York ; a reorganization carried out in 1947 placed L.A.V.'s operations under a Domestic and an International Division, respectively.

Principal routes : from Caracas to New York ; Maracaibo ; Santo Domingo ; Ciudad Bolivar ; Aruba ; Trinidad ; Havana ; etc.

42 Aerovias Guest S.A.

Reforma 95, Mexico City.

Aerovias Guest S.A. was organized in 1946 by Mexican and U.S. financial interests. Mexicans at present hold 60 percent, Americans (Winston Guest) 40 percent of the stock. The Company holds a 30-year Government concession for a regular mail, cargo and passenger service on the Mexico City—Madrid route, which was inaugurated in January, 1948. Aerovias Guest is planning to extend the service to Paris and London and has also applied for permission to operate to New York.

Principal routes : Mexico City—Lisbon—Madrid.

43 Compania Cubana de Aviacion S.A.

Prado 252, Havana.

Cubana is the successor of a company established in Cuba in 1929 by the Curtiss Aeroplane Co., Compania Nacional Cubana de Aviacion Curtiss, S.A. On May 6th, 1932, Pan American Airways acquired all outstanding stock and in 1934 shortened the Company's name to its present style. Cubana's international operations were inaugurated after the war when it started services to Miami ; last year the Company opened its route to Madrid and hopes to extend it to Barcelona and Paris some time in the future. Pan American gradually reduced its holding to the present level of 52 percent.

Principal routes : Havana—Bermuda—Azores—Lisbon—Madrid ; Havana—Miami ; Cuban local services.

44 Misrair

Almaza Airport, Heliopolis, Egypt.

Misr Airwork was incorporated in 1932 with the overwhelming financial backing of the Misr Bank, which was founded in 1920 to encourage Egyptian enterprises until they became self-supporting. Misr Airlines—which earlier this year was changed to Misrair—is the air transport division of Misr Airwork. The Company flourished in the years before the war. When hostilities broke out, it was taken over by the Government but retained its identity. It carried heavy loads of military passengers and goods and expanded its services. After the war it passed through a severe equipment crisis, which was finally solved by the purchase of twin-engined Beechcrafts and "Vikings." Misrair opened its first long overwater route—to Geneva—last spring.

Principal routes : Cairo to Baghdad ; Tehran ; Nicosia ; Istanbul ; Geneva.

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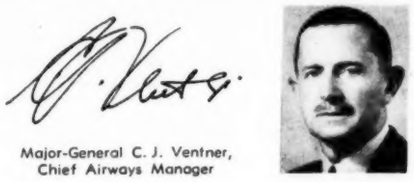
45 South African Airways (S.A.A.)

South African Railways & Harbours & Airways Administration, Johannesburg, Union of South Africa.

The South African Government in February, 1934, acquired Union Airways Ltd., and, under the name of South African Airways, made it a subsidiary of South African Railways, an autonomous Government corporation, and an integral part of the South African Railways & Harbours & Airways Administration. In 1935 the Government also acquired South West African Airways, thus bringing under Government control all internal air routes. From 1937 S.A.A.'s growth was greatly stimulated by the Empire Air Mail Scheme, which was abandoned upon the outbreak of hostilities. S.A.A. was forced to curtail and later suspend its operations during the war, because its 18 Junkers Ju-86 and 28 out of 29 Lockheed "Lodestars"—which had just arrived—were requisitioned for military purposes, leaving the Company with only 11 Junkers Ju-52s. Since the war the organization has rapidly expanded, despite lack of equipment due to the dollar shortage, and with the forthcoming delivery of its new "Constellations" S.A.A. will branch out to new European destinations and across the North Atlantic.

Principal routes : from Johannesburg to Capetown ; East London : Durban ; Salisbury (S. Rhod.) ; Port Elizabeth ; Lourenco Marques ; Cairo ; London. Routes to Amsterdam and New York are projected.



Major-General C. J. Ventner, Chief Airways Manager

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46 Central African Airways Corporation (C.A.A.C.)

Salisbury, S. Rhodesia.

Central African Airways was set up on June 6th, 1946, as the successor of the former Rhodesia and Nyasaland Airways. It is jointly owned by the Government of Southern Rhodesia, Northern Rhodesia and Nyasaland. Under the control of the Central African Air Transport Authority, it is required to provide air services within the Central African territories and feeder services to link with the routes to and through other territories. For the last two years C.A.A.C. has encountered considerable difficulties and lost large sums of money (£290,000 for 1947-1948). A thorough reorganization to rationalize operations and equipment was undertaken by a new management in the early summer of 1949. These measures are designed to limit C.A.A.C.'s annual deficit to £106,500.

Principal routes : Salisbury to Johannesburg ; to Nairobi ; Ndola to Elisabethville (Belgian Congo) and Johannesburg ; etc.

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47 West African Airways Corporation (W.A.A.C.)

Airways House, Lagos, Nigeria.

West African Airways Corporation was established in May, 1946, as a public Corporation under the jurisdiction of the (British) West African Air Transport Authority. It is owned jointly by the Governments of Nigeria, the Gold Coast, the Gambia and Sierra Leone. W.A.A.C. has a technical advisory agreement with B.O.A.C., but the latter has no financial interest in it. The Company is empowered to issue stock but so far does not seem to have done so. Operations began late in 1947 on the Lagos—Kano route and reached a route mileage of over 21,000 by the end of 1948.

Principal routes : serving about 30 stations in Nigeria, the Gold Coast, the Gambia, Sierra Leone and French West Africa.

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48 *East African Airways Corporation (E.A.A.C.)

Shell House, Delamere Avenue, Nairobi, Kenya.

East African Airways Corporation was established on January 1st, 1946, as a public corporation jointly owned by the Governments of Kenya, Uganda, Tanganyika and Zanzibar, and is the chosen instrument of these Governments for air services in the four territories. Its formation implemented plans elaborated as early as 1943. The Corporation is empowered to issue and sell stock to individuals but apparently has hitherto not done so. Operations actually started on November 1st, 1945, *i.e.*, before E.A.A.C.'s incorporation. In the beginning, E.A.A.C. suffered from equipment shortage. This has meanwhile been overcome by the acquisition of second-hand aircraft from other airlines and British flying equipment.

Principal routes : linking about 30 stations in the territories of Kenya, Uganda, Tanganyika and Zanzibar.

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49 Skyways (East Africa) Ltd.

Nairobi, Kenya.

Skyways (East Africa) Ltd. is an associate of Skyways Ltd., the large British charter operating firm. It was registered in Kenya to circumvent the ban preventing non-African charter carriers from opening air services between the African territories. For some time it ran a Nairobi—Dar es Salaam—Mauritius—Johannesburg service, but this has now been suspended because the British Colonial Office has refused to subsidize the operation.

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50 Divisao de Exploracao dos Transportes Aereos (D.E.T.A.)

Lourenco Marques, Mozambique.

D.E.T.A. was formed in 1937 as a special division of the Administration of Ports, Railways and Transports, and the first service, Lourenco Marques to Johannesburg, was opened in December of that year. D.E.T.A. grew steadily after that ; it suffered no ill effects from the war excepting the temporary suspension of its first route, and has since considerably expanded its operations.

Principal routes : Lourenco Marques—Johannesburg ; Beira—Salisbury (S. Rhod.) ; Beira—Mocimbon.

Near and Far Eastern Airlines

51 Cyprus Airways Ltd.

1, Onasagoras St., Nicosia, Cyprus.

Cyprus Airways is an affiliate of British European Airways Corp., which holds 44.5 percent of the Company. Formed on September 24th, 1947, it started its services on December 8th of the same year and has gradually expanded since. One of its main assignments is the transport of immigrants from Cyprus to Israel.

Principal routes : Nicosia to Cairo, Haifa, Lydda, Athens, Rome, Ankara, Istanbul, Khartoum.

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52 Compagnie Générale de Transport (C.G.D.T.) - Lignes Aériennes Libanaises

Beirut.

The constitution of the C.G.D.T. was authorized by Presidential decree in 1945, and the Company was formed by a number of prominent Lebanese and Syrian personalities. It is affiliated with Air France, but the extent of Air France's interest is not known. Operations were started with two Junkers Ju 52s in 1946 ; this fleet was increased by three DC-3s over the next two years, and by the end of 1948 the Company had raised its weekly aircraft mileage to 15,500, compared with 5,000 miles in 1946. C.G.D.T. is planning to extend its operations to Paris, Dakar, Lagos and Mecca.

Principal routes : Beirut to Cairo ; Jeddah ; Kuweit ; Istanbul ; Baghdad.

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53 Iraqi Airways

Baghdad.

Iraqi Airways was organized in December, 1945, as a department of Iraqi State Railways and began operations in January, 1946. The original financing, totalling I.D. 77,500, came from the 1945-1946 Iraqi State Railway budget, and any profits or losses are absorbed by the Iraqi Government. British Overseas Airways Corporation provides technical assistance and certain key personnel to Iraqi. — Iraqi Airlines operates predominantly international routes ; major purpose of the London service is the overhaul of the line's aircraft in England.

Principal routes : Baghdad to Athens—Rome—Marseilles—London ; Tehran ; Basra ; Mosul ; Damascus—Beirut ; Cairo ; Kuweit ; Karachi ; etc.

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54 Air-India Ltd. — "The Tata Line"

New India Assurance Building, Mahatma Gandhi Road, Fort, Bombay.

Air-India Ltd. is owned, managed and operated by the Aviation Department of Tata Sons, Ltd., the Indian "managing agency" and holding company for the world-famous Tata group of industrial and financial enterprises. Shortly after its establishment in 1932, Tata Air Lines, as it was first called, signed a contract with the Indian Government for the carriage of air mail between Karachi and Madras, via Bombay. As part of the British Empire Air Mail Scheme—under which all first-class mail was to be carried within the Empire without surcharge—Tata received a 15-year contract for the extension of services from Madras south to Colombo, Ceylon. This contract proved an enormous stimulant and made possible a vast expansion of Tata's operations. At the beginning of World War II the British Air Mail Scheme was dropped but Tata was more than compensated by military traffic. The Company was brought under Government control but did not lose its identity. It was released in December, 1945, and Tata thereupon took steps to acquire new flying equipment, notably surplus DC-3s and Vickers "Vikings." Air-India's subsidiary, Air-India International, has meanwhile inaugurated a high-speed "Constellation" service between Bombay and London.

Principal routes : from Bombay to Colombo; Delhi ; Karachi ; and Calcutta.

55 Air-India International Ltd.

New India Assurance Building, Mahatma Gandhi Road, Fort, Bombay.

Air-India International was promoted by Air-India Ltd. and Tata Sons, Ltd., the Managing Agents of Air-India, and the Government of India, for the purpose of operating international air services from India to Europe and other countries to the west of India. Air-India Ltd. are the Company's general technical managers and provide operational, engineering and administrative services to Air-India International. The Company started its services to London in June, 1948. It expects shortly to increase the frequency to three weekly schedules to the United Kingdom and to open a service to Aden and Nairobi.

Principal routes : Bombay—Basra—Cairo—Geneva—London.

J. R. D. Tata,
Chairman, Air-India Ltd. & Air-India International

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56 Indian National Airways Ltd. (I.N.A.)

Scindia House, Connaught Circus, New Delhi.

I.N.A. opened its first service, Karachi—Lahore, at the end of 1934 under an Indian Government air mail contract. As in the case of Air-India (Tata), this contract was superseded by a new 15-year agreement in 1938 as part of the British Empire Air Mail Scheme. Several new routes were inaugurated subsequently, even though the Company was placed under direct Government control during the war. It intensified its expansion after the Japanese capitulation and now plans to open feeder services linking all important towns in Northern India, as well as longer services to Bangkok and Cairo.

Principal routes : from Delhi to Calcutta ; Peshawar ; Karachi ; Lucknow ; Ahmedabad ; etc.

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57 *Indian Overseas Airlines Ltd.

Santa Cruz Airport, Bombay 25.

Indian Overseas Airlines is the air transport affiliate of an Indian industrial corporation and was registered as Mistri Airways Ltd. in 1946 It changed its name late in 1947. Operations began in 1946 on the Bombay—Calcutta route. The Company plans to open services from Calcutta to Sydney, via Singapore and Indonesia, as well as routes from Bombay to Karachi and Tehran.

Principal routes : Bombay—Calcutta ; Lucknow—Nagpur ; Madras—Delhi.

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58 *Deccan Airways Ltd.

Airport, Begumpet-Dn, India.

Deccan Airways Ltd. was formed in September, 1945, to take over the air transport functions formerly exercised by the Air Department of the Nizam's State railways. Of the shares issued 71 % have been taken up by the Hyderabad State Government and State Railway. The Company started operations in July, 1946, and now flies air services under a provisional licence granted by the Government of India following the incorporation of Hyderabad in the Indian Union. The Company has applied to the Indian air authorities for permission to operate a number of additional services.

Principal routes : Madras—Delhi, Hyderabad—Bangalore, Hyderabad—Bombay, etc.

P. M. Reddy, General Manager

59 Pak Air Ltd.

Bombay, Pakistan.

Pak Air Ltd. is one of the two Pakistan air carriers to be awarded route concessions under the Pakistan Government's civil aviation policy announcement of December 4th, 1947 (the other : Orient Airways). Pak Air is endeavouring to become Pakistan's everseas flag carrier and plans extensive services to Singapore, Australia (Sydney), Ceylon, Cairo and London. Last year it signed a $1,000,000 agreement with Transocean Air Lines, of Oakland, Calif., under which T.A.L. provided Pak Air with aircraft (DC-4s and DC-3s), air crews and technical assistance.

Principal routes : Karachi to Delhi, Lahore, Peshawar Bombay, etc.

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60 Air Ceylon

Ceylon Government Airlines, Lotus Road, Fort, Colombo, Ceylon.

Air Ceylon was formed by the Singhalese Government as a State organization in 1947. Earlier this year its constitution was changed into that of a State-owned airways corporation. Meanwhile, the Government concluded a ten-year agreement with the privately-owned Australian National Airways under which A.N.A. acquired a 49-percent stock interest in Air Ceylon and provides it with management and technical services. The Company's services to Sydney are operated on a charter basis pending the conclusion of an air agreement between Australia and Ceylon. — Air Ceylon holds a 16-percent interest in Air-India International.

Principal routes : Colombo—Singapore—Sydney ; Colombo—London ; etc.

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61 Philippine Air Lines Inc. (P.A.L.)

M. R. S. Building, Manila, Philippines.

Philippine Air Lines today is the Government's chosen instrument and the only Philippine scheduled airline. It achieved its present position as a major Asiatic air carrier through the acquisition of two other airlines. One of these was Far Eastern Air Transport Inc. (F.E.A.T.I.) which originally was incorporated as Iloilo-Negros Air Express Co. (I.N.A.E.C.) in April, 1932, but changed its name in November, 1945 ; F.E.A.T.I. was bought by P.A.L. in May, 1947. The second company, acquired by P.A.L. in September, 1946, was Commercial Air Lines Inc.(C.A.L.I.), which was formed only after the war, in May, 1946. The old P.A.L. was incorporated in February, 1941, the successor to Philippine Aerial Taxi Co., which was organized by U.S. interests in 1931 and later renamed Philippine Air Transport Co. (P.A.T.C.O.). The latter company went into bankruptcy in 1940. P.A.L. and F.E.A.T.I. were the first to resume operations after the war, F.E.A.T.I. on November 19th, 1945, and P.A.L. on February 14th, 1946, and the two companies operated competitive domestic networks. In August, 1946, the newly organized Philippine Civil Aeronautics Board approved the purchase by P.A.L. of both C.A.L.I. and F.E.A.T.I. Prior to the completion of these transactions, both F.E.A.T.I. and P.A.L. had begun non-scheduled flights across the Pacific to the U.S. and on June 5th, 1947, the U.S. Civil Aeronautics Board granted the route to P.A.L. : regular operations started on October 27th, 1947. The second major international route, that to London, was inaugurated on July 24th, 1948, and extended to Amsterdam shortly after.—Philippine Air Lines was one of the small group of international air carriers that made a profit in 1948. This was equivalent to $ 276,461, compared with a loss of $ 1,243,609 in 1947.

Principal routes : Manila, Guam, Wake, Honolulu, San Francisco ; Manila—Hong Kong ; Manila—Calcutta—Bangkok—Bombay—Karachi—Cairo—Rome—Madrid—London—Amsterdam.

Col. Andres Soriano, President

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62 China National Aviation Corporation (C.N.A.C.)[1]

2, Tientsin Road, Shanghai (now reported moved to Canton).

A year after its foundation in 1929 as a wholly Government-owned enterprise, China National Aviation Corporation was reorganized with a capital of CN$10,000,000 as a Sino-American company, 55 %-owned by the Chinese Government and 45 % by Chinese Airways Federal, Inc., an American concern. Pan American Airways bought the latter's holding in 1933. C.N.A.C. was again reorganized in 1946, with a capital of CN$2,500,000,000, 80 percent of which is held by the Kuomintang Government, 20 percent by Pan American Airways. — The Company's history has been varied : Operations gradually expanded after the inauguration of its first service, Shanghai—Hankow, in 1930. In 1938, however, the year following Japan's aggression, aircraft-miles flown dropped to half those of 1936. During the war it flew services radiating from Chungking, notably over "The Hump" to Burma. After the war it moved to Shanghai and began to develop its internal routes as well as those to points abroad and across the Pacific to the U.S.A. Its growth has now once more been checked by the advance of the Communist armies, and its operations are confined to points in southeast Asia and across the Pacific.

Principal routes : Canton—San Francisco ; points in China ; Hong Kong, Rangoon, Calcutta, Bangkok.

[1] Changes that have taken place since the Communist advance in China are not fully included.

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63 Central Air Transport Corporation (C.A.T.C.)[1]

2, Taming Road, Shanghai.

The predecessor company of Central Air Transport Corporation was Eurasia Aviation Co., which was established in 1931 under an agreement between the Chinese Government and the Deutsche Lufthansa ; the Chinese Government held a two-thirds interest in the corporation. The company set up a dense network of services with the ultimate purpose of flying to Europe. When war broke out, Eurasia was inoperative for a time and, in 1943, the Chinese Government dissolved it and re-incorporated the organization as a fully Government-owned corporation. After the war C.A.T.C. obtained equipment from U.S. Army surplus stocks and also placed an order for 6 "Convair-Liners." Its services have now had to be curtailed again as a result of the Communist advance, although the Communist authorities have permitted C.A.T.C. to resume flights to Peking.

Principal routes : Radiating from Canton.

[1] Changes that have taken place since the Communist advance in China are not fully included.

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64 Hong Kong Airways Ltd.

Kaitak Airport, Hong Kong.

Hong Kong Airways is a fully-owned subsidiary of British Overseas Airways Corp. It was registered on March 4th, 1947, but started operations only on December 2nd of that year. As a result of the war in China, the Company had to abandon its service to Shanghai but has opened a route to Manila, Philippines. It is reported that Hong Kong Airways plans to replace its DC-3s with Short flying-boats.

Principal routes : Hong Kong to Canton ; Manila.

Australian and New Zealand Airlines

65 British Commonwealth Pacific Airlines Ltd. (B.C.P.A.)

A. P. A. Building, 53, Martin Place, Sydney, Australia.

British Commonwealth Pacific Airlines Ltd. is owned by the Australian, New Zealand and British Governments, in the proportion of 50 percent by Australia, 30 percent by New Zealand and 20 percent by the United Kingdom. The formation of the Company was first considered during the Inter-Dominion conference on aviation at Montreal in 1944, but it was not created until June 24th, 1946, as a result of the British Commonwealth Civil Aviation Conference in Wellington, New Zealand, in March, 1946. Services on the Sydney—Vancouver route were commenced on September 15th, 1946. Since B.C.P.A. had no equipment at the time, operations were conducted on its behalf by Australian National Airways under a contract which expired at the end of April, 1947. On that date B.C.P.A. began to fly the Pacific routes itself with Douglas DC-4s, which meanwhile have been replaced with Douglas DC-6s. Previously, on December 4th, 1946, an Australian-U.S. air agreement was signed, giving B.C.P.A. the right to pick up and land passengers and cargo on U.S. territory on its flights to and from Vancouver.

Principal routes : Sydney or Auckland to Fiji, Canton Island, Honolulu, San Francisco, Vancouver.

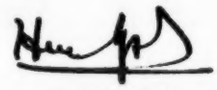
Capt. A. A. Barlow, General Manager

66 Qantas Empire Airways Ltd. (Q.E.A.)

Shell House, Carrington St., Sydney.

In 1919 the Australian Federal Government commissioned Lieutenants Hudson Fysh (now Chairman of Q.E.A.) and P.J. McGinniss to survey an air route from Darwin to Longreach. This led to the formation of Queensland and Northern Territory Aerial Services Ltd., the original "Qantas" company, on November 16th, 1920. The first regular service was inaugurated in November, 1922. On January 18th, 1934, Qantas Empire Airways was registered, the initial capital of the Company being owned on a 50-50 basis by the original Queensland and Northern Territory Aerial Services Ltd. and Imperial Airways Ltd.; upon the formation of British Overseas Airways Corporation, the latter took over I.A.L.'s holding. On March 21st, 1947, the Australian Government purchased B.O.A.C.'s interest in Qantas Empire Airways; on July 1st, 1947, it also bought the holding of the original Qantas company and thus became the sole shareholder of Q.E.A. On December 1st, 1947, the Company inaugurated its major high-speed trunk route, the Sydney—London "Constellation" service. — Q.E.A. is responsible for the development and operation of Australian airline services outside the Australian mainland, the Government's domestic services being the responsibility of Trans Australia Airlines.

Principal routes: Sydney to London; Hong Kong; Tokyo (for R.A.A.F.); Lae (New Guinea); internal New Guinea services; etc.



W. Hudson Fysh,
Chairman and Managing Director

67 *Trans Australia Airlines (T.A.A.)

339 Swanston Street, Melbourne, C. 1.

Trans Australia Airlines was set up in 1946 by the Government's Australian National Airlines Commission which in turn had been created under the Australian National Airlines Act of 1945. The Act authorized the Government to engage in air transportation, but the constitutionality of the Act has been challenged ever since by the Australian privately-owned companies. T.A.A. started operations on September 9th, 1946, with a flight between Melbourne and Sydney, and by December of that year all State capitals had been linked. T.A.A. claims to serve the largest unduplicated route mileage of any internal airline in the world. The Government has set T.A.A. the important task of developing the Australian outback, and two of its main services, namely, from Adelaide to Darwin and Brisbane, pass through vast stretches of country in which each town is many hundreds of miles away from its nearest neighbour.

Principal routes: domestic air services connecting 31 points.

L. J. Brain, General Manager

68 *Australian National Airways Pty., Ltd. (A.N.A.)

390 Flinders Street, Melbourne, C 1.

The inaugural operation of Australian National Airways took place in 1932, when Captain Victor Holyman, of the well-known shipping family of that name, bought a D.H. "Fox Moth" aircraft and opened a service between Launceston and Flinders Island, across the Bass Strait. His company, Holyman Airways Pty., Ltd., expanded rapidly and gradually bought up other companies, including Adelaide Airways, West Australian Airways, and Airways of Australia. The resultant Australian National Airways was formally registered on July 1st, 1936, with a capital of £A500,000 subscribed mainly by four Australian and one New Zealand shipping companies, which still own about 94 percent of the present issued capital of £A1,000,000. In recent years A.N.A.'s expansion as a scheduled carrier has been checked by the subsidized competition of the Australian Government's Trans Australia Airlines. A.N.A. has been forced to look to the international contract carrier market to extend its activities (see British Commonwealth Pacific Airlines!) and is now operating the Singapore—Colombo—London service for Air Ceylon. In addition to its regular domestic services, it flies numerous charter flights to Rome and Hong Kong.

Principal routes: domestic, connecting the capitals of all Australian States; overseas operations as contractors for Air Ceylon.

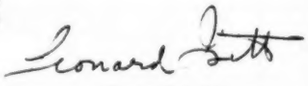
Ivan Nello Holyman, President

69 Tasman Empire Airways Ltd. (T.E.A.)

Mechanics Bay, Auckland, New Zealand.

Purpose of the formation of Tasman Empire Airways in 1939—following negotiations extending more than three years—was the establishment of the final link in the Empire airways system from the United Kingdom to India, Australia and New Zealand. The company began operations on the trans-Tasman sea route at the end of April, 1940. It is owned by the three Governments interested in the service: 39 percent by the Government-owned New Zealand National Airways Corporation, 38 percent by the British Overseas Airways Corp., and 23 percent by the Australian Government's Qantas Empire Airways.

Principal route: Auckland—Sydney.



Sir Leonard Isitt,
Chairman, T.E.A. and N.Z.N.A.C.

70 New Zealand National Airways Corporation (N.Z.N.A.C.)

Post Office Box 3038, Wellington C. 1., New Zealand.

Under the New Zealand National Airways Act of 1945 the three companies operating domestic routes, Union Airways, Air Travel (N.Z.) Ltd., and Cook Strait Airways, were nationalized in August, 1946, to form one comprehensive airline, N.Z.N.A.C. The Corporation is responsible for domestic services but also flies routes beyond the mainland, such as those to Fiji. In the first two years of its existence N.Z.N.A.C. increased its routes and services by about 200 percent over the combined performance of its predecessor companies.

Principal routes: Auckland to Fiji, Samoa, etc.; domestic services.

"Who's Who"

1. CAPITALIZATION: **A** = Authorized; **I** = Issued or present; **L** = Long-term loan; **O** = Original.

2. OWNERSHIP: **AF** = Air France; **Airwk.** = Airwork Ltd.; **ANA** = Australian National Airways; **G** = Government; **Grace** = W. R. Grace & Co.; **Maj.** = Majority; **Misr** = Misr Bank; **P** = Private; **ScAv.** = Scottish Aviation, Ltd.; **SL** = Shipping Lines.

3. MANAGEMENT — EXECUTIVE CAPACITIES:

AGM	Assistant General Manager	DChEx	Deputy Chief Executive	MD	Managing Director	TrM	Traffic Manager
AMD	Assistant Managing Director	DG	Director General	OD	Operations Director	VP-En	Vice President-Engineering
C	Chairman	DMD	Deputy Managing Director	OM	Operations Manager	VP-GC	Vice President-General Counsel
ChAM	Chief Airways Manager	Ea. Div.	Eastern Divison	P	President	VP-GM	Vice President-General Manager
ChAS	Chief Airways Superintendent	ExAsstP	Executive Assistant to President	SM	Sales Manager	VP-O	Vice President-Operations
ChEn	Chief Engineer	ExVP	Executive Vice-President	T	Technical	VP-S	Vice President-Sales
ChEx	Chief Executive	GM	General Manager	TD	Technical Director	VP-Tr	Vice President-Traffic
CD	Commercial Director	GM-O	General Manager—Operations	TM	Technical Manager	We. Div.	Western Division
CM	Commercial Manager	M	Manager				

"Who's Who"

NAME	YEAR OF FOUNDATION	CAPITALIZATION (1)	OWNERSHIP (2)	MANAGEMENT NAME	MANAGEMENT CAPACITY (3)	AIR FLEET	ROUTE MILEAGE (Unduplicated)
EUROPEAN AIRLINES							
1 **BOAC** British Overseas Airways Corporation	1940	A: £50,000,000 I: £34,500,000	G	Sir Miles Thomas Whitney W. Straight Sir Victor H. Tait J. W. S. Brancker V. G. Crudge	C ChEx DChEx GMEa. Div. GMWe.Div.	10 Lockheed "Constellations" 10 Boeing "Stratocruisers" 22 Canadair DC-4M-2s 6 Douglas DC-3s 25 H. P. "Hermes" 23 Avro "Yorks" 13 Avro "Lancastrians" 26 Short flying-boats 135	60,000 miles 96,500 km
2 **BEAC** British European Airways Corporation	1946	A: £20,000,000 I: £ 6,000,000	G	Lord Douglas of Kirtleside Peter Masefield P. C. F. Lawton A. H. Milward G. O. Waters	C DChEx CM GM Cont. GM Brit.	20 Airspeed "Ambassadors" 41 Vickers "Vikings" 27 Douglas DC-3s 19 D. H. "Dragon Rapides" 4 Helicopters 111	13,382 miles 21,536 km
3 **BSAAC** British South American Airways Corp.	1946	A: £10,000,000 I: £ 3,500,000	G	John W. Booth Capt. A. Gordon Store B. G. Porter	C,MD GM GM	10 Avro "Yorks" 5 Avro "Tudors" 15	20,000 mi. approx. 32,000 km approx.
4 **ALT** Aer Lingus Teoranta	1936	A: £5,000,000 I: £ 952,000 O: £ 100,000	60% G 30% BEAC 10% BOAC	J. F. Dempsey Maj.-Gen. M. Hogan Capt. J. C. Kelly-Rogers Capt. W. J. Scott Capt. P. McCormack	GM AGM AGM(T) OM ChEn	13 Douglas DC-3s 1 Airspeed "Consul" 14	2,227 miles 3,584 km
Scandinavian Airlines System							
5 **ABA** A. B. Aerotransport	1924	I: Kr. 50,000,000 O: Kr. 356,000	50% G 50% P	Per A. Norlin Karl Lignell Ake Weimar Olaf Carlstein	P ExVP VP-O VP-En	8 Douglas DC-6s 5 Douglas DC-4s 14 Douglas DC-3s 27	85,199 miles 137,114 km for entire SAS
6 **DNL** Det Norske Luftfartselskap A/S	1918/1946	A: Kr. 25-30,000,000 I: Kr. 25,250,000	19.8% G 49.4% SL 30.8% P	Maj.-Gen. Hj. Riiser-Larsen Johan Bostad Paul H. Kanter	P VP-O VP-Tr,S	2 Douglas DC-6s 2 Douglas DC-4s 9 Douglas DC-3s 3 Short "Sandringhams" 4 Junkers JU 52s 20	
7 **DDL** Det Danske Luftfartselskab A/S	1918	I: Kr. 30,000,000 O: Kr. 1,000,000	17% G 83% P	Per Kampmann K. Kalm K. Lybye	P ExVP ExVP	2 Douglas DC-6s 2 Douglas DC-4s 11 Douglas DC-3s 3 Vickers "Vikings" 1 Junkers JU 52 19	
8 **Aero O/Y** Finnish Airlines	1923	I: Fmk. 60,000,000 O: Fmk. 50,000	73% G	Lt.-Gen. Leonard Grandell Adolf Nyström Bertel Aulin	P CD TD	8 Douglas DC-3s	2,745 miles 4,418 km
9 **KLM** Royal Dutch Airlines Koninklijke Luchtvaart Maatschappij N. V.	1919	I: Fl. 120,000,000 O: Fl. 1,000,000	Maj. G	Dr. Albert Plesman Dr. M. J. van der Ploeg Dr. L. H. Slotemaker W. C. J. Versteegh	P ExVP VP VP	16 Lockheed "Constellations" 7 Douglas DC-6s 11 Douglas DC-4s 36 Douglas DC-3s 12 Convair-Liners 1 Auster J-1 83	79,397 miles 127,777 km
10 **SABENA** Société Anonyme Belge d'Exploitation de la Navigation Aérienne	1923	I: B. Fr. 300,000,000 O: B. Fr. 6,000,000	50% G 50% P	Gilbert Périer Gaston Claeys Léon Schoevaerts Anselme Vernieuwe Fernand de Ridder Félicien Pirson	P MD CD OD TD TD	3 Douglas DC-6s 8 Douglas DC-4s 25 Douglas DC-3s 6 Convair-Liners 6 D. H. "Doves" 12 Miscellaneous 60	34,000 miles 55,000 km
11 **COBETA** Compagnie Belge de Transports Aériens	1943	...	P	Marcel L. M. Dens	MD	2 Douglas DC-4s 2 Douglas DC-3s 14 Miscellaneous 18	4,191 miles 6,744 km
12 **SWISSAIR** Swiss Air Transport Co. Ltd.	1931	I: Sw. Fr. 20,000,000 O: Sw. Fr. 800,000	30% G 70% P	Dr. Rudolf Speich Eugène Groh Gottfried de Meiss	C CD TD	4 Douglas DC-4s 14 Douglas DC-3s 4 Convair-Liners 7 Miscellaneous 29	21,284 miles 34,254 km
13 **AIR FRANCE** Compagnie Nationale Air France	1933/1948	I: Frs. 10,000,000,000 O: Frs. 120,000,000	85% G 15% P	Dr. Max Hymans Henry Ziegler René Briend Raymond Dupré	C MD AMD,CD TD	14 Lockheed "Constellations" 25 Douglas DC-4s 28 Douglas DC-3s 32 SE 161 "Languedocs" 6 Miscellaneous 105	105,880 miles 170,400 km
14 **IBERIA** Compania Mercantil de Lineas Aereas Espanolas S. A.	1940	I: Ptas. 90,000,000 O: Ptas. 12,000,000	G	Jesus Rubio Paz Cesar Gomez Lucia Jose M. Ansaldo	C P OM	4 Douglas DC-4s 9 Douglas DC-3s 3 Junkers JU 52s 3 D. H. "Dragon Rapides" 19	11,652 miles 18,752 km
15 **TAP** Transportes Aereos Portugueses	1944	State operation	G	Col. Carlos M. Magalhaes Maj. L. C. T. Bettencourt R. O. da Silva	GM TM CM	3 Douglas DC-4s 6 Douglas DC-3s 1 Beechcraft 18 10	9,971 miles 16,460 km
16 **Aero-Portuguesa Ldo.**	1934	...	37.5% SL 37.5% AF 25% P	Cdr. J. J. de Vasconcellos	M	1 Lockheed "Lodestar" 1 Douglas DC-3 2	279 miles 449 km
17 **CTA** Companhia de Transportes Aereos	1945	I: Esc. 5,000,000	P	Manuel de Mello C. E. Bleck	C MD	2 Douglas DC-3s 4 Miscellaneous 6	
18 **ALITALIA** Aerolinee Italiane Internazionali	1946	I: Lire 1,500,000,000 O: Lire 900,000,000	40% BEAC 40% G 20% P	Count Nicolo Carandini	C	5 Fiat G. 12 L. 5 Siai-Marchetti SM. 95 5 Avro "Lancastrians" 15	21,834 miles 35,128 km
19 **ALI** Avio Linee Italiane —Flotte Riunite	1926/1949	I: Lire 1,000,000,000 O: Lire 2,000,000	Maj. Fiat	Dr. Guido Ulisse Ringler General Felice Porro Major Aldo Casale A. Buzio G. Baccoglini	P VP VP CM TM	3 Fiat G. 212 4 Fiat G. 12 12 Douglas DC-3s 19	8,313 miles 13,378 km
20 **TAE** Greek Airlines (Technical & Aeronautical Exploitations Co.Ltd.)	1939	I: Drs. 1,000,000,000 O: Drs. 2,600,000	P 35% TWA	Colonel Stephen A. Zotos Lt.-Col. L. Papastratigakis Lt.-Col. P. Razelos	MD TM OM	10 Douglas DC-3s 1 Fairchild "Forwarder" 11	3,868 miles 6,225 km
21 **"Helles"** Hellenic Airlines S.A.	1947	I: Drs. 6,875,000,000 O: Drs. 1,000,000,000	60% G 40% ScAv.	J. Sakellion Air Vice-Marshal N. Voyazis Ch. Carolou Admiral A. Matessis	P MD DMD GM	5 Douglas DC-3s 1 Consolidated "Liberator" 6	4,800 mi. approx. 7,700 km approx.

	NAME	YEAR OF FOUNDATION	CAPITALIZATION (1)	OWNERSHIP (2)	MANAGEMENT NAME	CAPACITY (3)	AIR FLEET	ROUTE MILEAGE (Unduplicated)
22	**CSA** Ceskoslovenske Aerolinie	1923	State operation	G	Leopold Thurner Oldrich Ruzicka	DG TD	30 Douglas DC-3s 4 Ilyushin 11-18s 10 Miscellaneous 44	10,000 mi. approx. 16,000 km approx.
23	**LOT** Polskie Linie Lotnicze	1929	O: Zl. 8,000,000	G	Czeslaw Mankiewicz T. Cygo-Karpinski	DG TD	5 SE 161 "Languedocs" 26 Li-2s 5 Douglas DC-3s 36	6,500 mi. approx. 10,500 km approx.
	AMERICAN & CANADIAN AIRLINES							
24	**PAA** Pan-American World Airways	1927	I: $68,988,957 L: $35,000,000 O: $ 3,378,846	P	Juan Terry Trippe Samuel F. Pryor Willis G. Lipscomb Henry J. Friendly	P VP VP-Tr,S VP-GC	20 Boeing "Stratocruisers" 18 Lockheed "Constellations" 65 Douglas DC-4s 19 Douglas DC-3s 20 Convair-Liners 10 Curtiss "Commandos" 152	67,374 miles 108,428 km
25	**PANAGRA** Pan American-Grace Airways Inc.	1928	I: $4,750,000	50 % PAA 50 % Grace	Andrew B. Shea Douglas Campbell Christopher de Groot	P VP,GM TM	6 Douglas DC-6s 12 Douglas DC-3s 3 Douglas DC-4s 21	9,000 mi. approx. 14,500 km approx.
26	**AA** American Airlines, Inc.	1934	A: $72,000,000 I: $46,000,000	P	C. R. Smith L. G. Fritz Wm. Littlewood	P VP-O VP-En	50 Douglas DC-6s 22 Douglas DC-4s 75 Convair-Liners 147	10,817 miles 17,408 km
27	**AOA** American Overseas Airlines, Inc.	1937/1945	A: $3,000,000 I: $1,749,825	P	C. R. Smith H. R. Harris	P VP,GM	8 Boeing "Stratocruisers" 7 Lockheed "Constellations" 9 Douglas DC-4s 1 Douglas DC-3s 25	13,029 miles 20,968 km
28	**TWA** Transcontinental & Western Air Inc. (Trans World Airline)	1926/1930	I: $59,123,360 O: $ 5,000	P	Ralph S. Damon Warren Lee Pierson John A. Collings E. O. Cocke	P C VP-O VP-S	55 Lockheed "Constellations" 12 Douglas DC-4s 72 Douglas DC-3s 5 Boeing "Stratoliners" 144	24,597 miles 39,584 km
29	**UAL** United Air Lines Inc.	1926/1931	I: $30,172,767 O: $ 8,794,079	P	W. A. Patterson J. R. Herlihy Harold Crary	P VP-O VP-Tr,S	7 Boeing "Stratocruisers" 39 Douglas DC-6s 30 Douglas DC-4s 73 Douglas DC-3s 149	10,700 miles 17,200 km
30	**EAL** Eastern Air Lines Inc.	1928/1934	A: $ 5,000,000 I: $ 2,395,572 L: $16,000,000	P	Capt. Edward V. Rickenbacker Paul H. Brattain S. L. Shannon Hanley de J. Osborne	P, GM 1st VP 2nd VP VP-Tr,S	22 Lockheed "Constellations" 19 Douglas DC-4s 52 Douglas DC-3s 93	10,000 mi. approx. 16,000 km approx.
31	**Northwest Airlines Inc.**	1934	I: $17,958,080	P	Croil Hunter K. R. Ferguson R. O. Bullwinkel	P, GM VP-O,En VP-Tr	10 Boeing "Stratocruisers" 18 Douglas DC-4s 13 Douglas DC-3s 24 Martin 2-0-2s 65	20,454 miles 32,917 km
32	**Braniff Airways Inc.**	1928/1930	I: $2,500,000 O: $ 10,000	P	Thomas E. Braniff Charles E. Beard Ray E. Shrader	P ExVP	6 Douglas DC-6s 9 Douglas DC-4s 17 Douglas DC-3s 32	11,430 miles 18,395 km
33	**TCA** Trans-Canada Air Lines	1937	A: $25,000,000	G	G. R. McGregor W. F. English Anson C. McKim	P VP-O VP-Tr	20 Canadair DC-4M-2s 27 Douglas DC-3s 47	16,400 miles 26,400 km
34	**CPA** Canadian Pacific Airlines Ltd.	1942	Owned by Canadian Pacific Railways	P	Grant W. G. McConachie Duncan I. McNeill R. W. Ryan W. G. Townley	P VP ExAsstP GM-O	4 Canadair DC-4M-2s 17 Douglas DC-3s 21 Miscellaneous 42	24,085 miles 38,761 km
	LATIN AMERICAN AIRLINES							
35	**FAMA** Aerolineas Argentinas FAMA	1945	I: Ps. 150,000,000	G	Fermin José Donzelli Maj. A. E. Etchegaray Atilio Aballay Maj. D. Italo Cerri	DG OM CM TM	6 Douglas DC-6s 11 Douglas DC-4s 3 Avro "Yorks" 20	17,148 miles 27,588 km
36	**LAN** Linea Aerea Nacional-Chile	1929	I: Ps. 5,500,000 O: Ps. 250,000,000	G	Juan del Villar Araya Luis Carmona Lopehandia Oscar Gonzales Gonzales	ExVP OM ChEn	4 Martin 2-0-2s 6 Douglas DC-3s 11 Miscellaneous 21	3,670 miles 5,900 km
37	**PANAIR** Panair do Brasil	1929	A: Cr$100,000,000 I: Cr$ 88,000,000 O: Cr$ 500,000	48 % PAA 52 % P	Dr. Paulo de Oliveira Sampaio F. M. Sampaio A. E. Basilio E. Schoueri	P GM TM SM	5 Lockheed "Constellations" 19 Douglas DC-3s 4 Consolidated "Catalinas" 28	50,000 miles 80,500 km
38	**CRUZEIRO** Servicos Aereos Cruzeiro do Sul	1927/1942	I: Cr$20,000,000 O: Cr$ 100,000	P	Dr. Jose Bente Ribeiro Dantas Col. Franklin A. Rocha Joao Q. Vieira de Carvalho	P OM CM	2 Douglas DC-4s 22 Douglas DC-3s 4 Beechcraft 18 28	10,059 miles 16,188 km
39	**VARIG** S. A. Empresa de Viacao Aereo Rio Grandense	1927	I: Cr$ 2,000,000 L: Cr$12,000,000 O: Cr$ 1,000,000	21 % G 79 % P	Rubem M. Berta Oscar Siebel Karl H. Ruhl	P,GM VP TD	12 Douglas DC-3s 4 Curtiss "Commandos" 12 Miscellaneous 28	3,179 miles 5,116 km
40	**AVIANCA** Aerovias Nacionales de Colombia	1919/1940	I: Ps. 6,000,000 O: Ps. 800,000	48,2 % PAA 51,8 % P	Dr. Jorge Restrepo Hoyos Jorge A. Gonzalez Col. Ernesto Buenaventura	P,GM ExVP OD	6 Douglas DC-4s 23 Douglas DC-3s 2 Consolidated "Catalinas" 31	13,319 miles 22,435 km
41	**LAV** Linea Aeropostal Venezolana	1933	I: Bs. 14,656,897 O: Bs. 1,156,897	G	Dr. Paulo Garcia Perez	MD	2 Lockheed "Constellations" 2 Douglas DC-4s 16 Douglas DC-3s 4 Miscellaneous 24	6,657 miles 10,714 km
42	**Aerovias Guest S. A.**	1946	I: Ps. 5,000,000	P	W. F. C. Guest	P	3 Douglas DC-4s	5,756 miles 9,263 km
43	**CUBANA** Compania Cubana de Aviacion S. A.	1930	A: Ps. 1,000,000	52 % PAA 48 % P	Antonio Tarafa Warren A. Pine	P VP,GM	4 Douglas DC-4s 6 Douglas DC-3s 10	7,000 mi. approx. 11,300 km approx.
	AFRICAN AIRLINES							
44	**Misrair S. A. E.**	1932	O: £E. 80,000	85 % Misr 10 % Airwk 5 % P	Mohammed Roushdy Bey	MD,GM	4 Vickers "Vikings" 16 Miscellaneous 20	3,800 miles 6,100 km
45	**SAA** South African Airways	1934	State operation	G	Maj.-Gen. C. J. Ventner H. C. J. Viljoen	ChAM ChAS	7 Douglas DC-4s 4 Douglas DC-3s 19 Lockheed "Lodestars" 4 Lockheed "Constellations" 8 Vickers "Vikings" 2 D. H. "Doves" 44	14,815 miles 23,843 km

NAME	YEAR OF FOUNDATION	CAPITALIZATION (1)	OWNERSHIP (2)	MANAGEMENT NAME	MANAGEMENT CAPACITY (3)	AIR FLEET	ROUTE MILEAGE (Unduplicated)
46 CAAC Central African Airways Corporation	1946	L: £880,000 O: £500,000	G	Sir Ellis Robins P. J. B. Wimbush R. A. R. Wieland C. B. Sinton	C GM CM OM	5 Vickers "Vikings" 7 D. H. "Doves" 12	4,773 miles 7,681 km
47 WAAC West African Airways Corporation	1946	State operation	G	Sir Hubert Walker Bernard C. H. Cross D. Malcolm Brown	C GM TrM	10 D. H. "Doves" 2 Bristol 170s 12	16,565 miles 26,658 km
48 ✠EAAC East African Airways Corporation	1946	State operation	G	Sir Reginald Robins Capt. M. Sorsbie A. N. Francombe	C GM TM	4 Douglas DC-3s 8 Lockheed "Lodestars" 4 D. H. "Doves" 8 D. H. "Dragon Rapides" 24	5,000 mi. approx. 8,000 km approx.
49 Skyways (East Africa) Ltd.	...	...	P	...		6 Avro "Lancastrians"	3,852 miles 6,200 km
50 DETA Divisao de Exploracao dos Transportes Aereos	1937	State operation	G	Lt.-Col. Pinho da Cunha	M	3 Douglas DC-3s 2 Lockheed "Lodestars" 1 Lockheed 14 5 D. H. "Dragon Rapides" 6 Miscellaneous 17	2,143 miles 3,449 km
NEAR & FAR EASTERN AIRLINES							
51 Cyprus Airways Ltd.	1947	A: £250,000 I: £125,000	44,5% BEAC 20% G 35,5% P	Cdr. V. Wolfson James A. Vick	C MD	6 Douglas DC-3s	1,600 mi. approx. 2,600 km approx.
52 CGDT Compagnie Générale de Transports (Lignes Aériennes Libanaises)	1945	I: £500,000	P	Basil Meguerdiche I. Champaloux	P OM	3 Douglas DC-3s 2 Junkers Ju 52s 5	3,476 miles 5,595 km
53 Iraqi Airways	1945	O: I. D. 77,500	G	Col. Sabah es Said Col. M. C. P. Mostert Sayid Kanaan el Askari	GM TM CM	3 Vickers "Vikings" 3 D. H. "Doves" 6	5,241 miles 8,385 km
54 Air-India, Ltd. "The Tata Line"	1932	I: £3,750,000 O: £ 900,000	P	J. R. D. Tata B. W. Figgins	C GM	13 Douglas DC-3s 10 Vickers "Vikings" 3 Miscellaneous 26	3,783 miles 6,280 km
55 Air-India International, Ltd.	1948	A: Rs. 70,000,000 I: Rs. 20,000,000	P	J. R. D. Tata Sir Gurunath Bewoor K. J. Bhore A. O. Gazdar S. K. Kooka	C MD GM OM TrM	3 Lockheed "Constellations"	4,325 miles 6,960 km
56 INA Indian National Airways, Ltd.	1933	I: Rs. 6,300,000 A: Rs. 16,300,000	P	V. H. Dalmia B. Mukerjee	MD GM	5 Vickers "Vikings" 6 Douglas DC-3s 4 Bristol 170s 2 Miscellaneous 17	2,930 miles 4,715 km
57 ✠IOA Indian Overseas Airlines, Ltd. ("Star Line")	1946/1947	Privately-owned	P	J. M. Akhaney M. U. Parekh	C GM	12 Douglas DC-3s 15 Noorduyn "Norsemans" 6 Miscellaneous 33	3,000 mi. approx. 4,800 km approx.
58 ✠Deccan Airways, Ltd.	1945	A: Rs. 10,000,000 I: Rs. 5,000,000 O: Rs. 2,500,000	71% G 29% P	P. M. Reddy C. A. Goodey V. K. Reddy	GM,OM ChEn TrM	12 Douglas DC-3s 2 Miscellaneous 14	2,711 miles 4,363 km
59 Pak Air, Ltd.	1948	A: Rs. 10,000,000 I: Rs. 5,500,000 O: Rs. 5,100,000	P	Hussain Malik Mahmood A. Haroon D. T. McArthy	MD AGM OD	2 Douglas DC-4s 5 Douglas DC-3s 7	2,086 miles 3,357 km
60 Air Ceylon, Ltd.	1947	Semi-State operation	51% G 49% ANA	B. F. M. Amarskera	CM	3 Douglas DC-4s 4 Douglas DC-3s 7	13,000 mi. approx. 21,000 km approx.
61 PAL Philippine Air Lines Inc.	1941	A: Ps. 10,000,000 O: Ps. 500,000	53% G 47% P	Col. Andres Soriano E. T. Bolton B. L. Anderson	P OM CM	4 Douglas DC-6s 3 Douglas DC-4s 39 Douglas DC-3s 15 Miscellaneous 61	19,772 miles 31,819 km
62 CNAC China National Aviation Corporation	1929	I: CN$2,500,000,000 O: CN$ 10,000,000	80% G 20% PAA	Col. C. Y. Lin E. M. Allison	P GM	6 Douglas DC-4s 22 Douglas DC-3s 18 Curtiss "Commandos" 46	25,000 miles 40,000 km
63 CATC Central Air Transport Corporation	1931/1943	I: CNC$20,000,000	G	C. L. Chen	P,MD	20 Douglas DC-3s 25 Curtiss "Commandos" 5 Miscellaneous 50	8,213 miles 19,000 km
64 Hong Kong Airways Ltd.	1947	I: £24,750	BOAC	D. F. Landale	C	4 Douglas DC-3s	1,000 mi. approx. 1,600 km approx.
AUSTRALIAN & NEW ZEALAND AIRLINES							
65 BCPA British Commonwealth Pacific Airlines	1946	A: £A.5,000,000 O: £A.2,000,000	50 % Aus. G. 30 % NZ. G. 20 % Br. G.	Captain A. A. Barlow J. H. Bennett J. B. Mills	GM OM ChEn	4 Douglas DC-6s	9,754 miles 15,690 km
66 QEA Qantas Empire Airways Ltd.	1920/1934	I: £A.3,423,000 O: £A. 120,000	G	W. Hudson Fysh H. H. Harman W. H. Crowther T. H. Wright	C,MD GM OM ChEn	5 Lockheed "Constellations" 15 Douglas DC-3s 2 Consolidated "Catalinas" 2 Avro "Lancastrians" 7 D. H. "Dragon Rapides" 1 Miscellaneous 32	30,862 miles 49,667 km
67 ✠TAA Trans-Australia Airlines	1946	I: £A.4,370,000 O: £A. 300,000	G	L. J. Brain J. P. Ryland J. L. Watkins J. Chapman	GM AGM TM OM	5 Convair-Liners 3 Douglas DC-4s 23 Douglas DC-3s 3 Miscellaneous 34	13,497 miles 21,721 km
68 ✠ANA Australian National Airways Pty., Ltd.	1936	A: £A.1,500,000 I: £A.1,000,000 O: £A. 500,000	P	Ivan Nello Holyman Herbert Fitzgerald Walsh John Stubbs L. McK. Johnson	P GM ChEn OM	9 Douglas DC-4s 24 Douglas DC-3s 3 Bristol 170s 2 Miscellaneous 38	20,956 miles 33,726 km
69 TEA Tasman Empire Airways, Ltd.	1939	I: £750,000 O: £500,000	G 39 % NZNAC 38 % BOAC 23 % QEA	Sir Leonard Isitt G. N. Roberts Capt. K. A. Brownjohn G. B. Bolt	C GM OM ChEn	4 Short flying-boats 1 Consolidated "Catalina" 5	1,340 miles 2,160 km
70 NZNAC New Zealand National Airways Corp.	1946	I: £1,225,000 O: £ 300,000	G	Sir Leonard Isitt F. Maurice Clarke	C GM	13 Douglas DC-3s 11 Lockheed "Lodestars" 2 Short "Sunderlands" 7 D. H. "Dragon Rapides" 6 Miscellaneous 39	2,580 miles 4,150 km

The Air Hostess Told Us...

Aviation and the Bejewelled Mink Fez

It had to happen, says Esmeralda, our Favourite Air Hostess. The woman's hat has invaded aeronautics. Aviation has become hat-conscious. It was inevitable, for women's hats make the world go round.

Haven't you ever watched a lady being helped out of her Rolls-Royce at the Ritz ? If her head is bare, the commissionaire's behaviour is strictly correct. If she wears a hat that is just a hat, his manners are correct *and* courteous. But if the lady wears a particularly atrocious piece of headgear, a combination of the Hanging Gardens of Babylon, Carmen Miranda and the birdhouse of the zoo, he bows and scrapes in a way that would make Sir Walter Raleigh look like a yokel.

Thus, hats can be useful, particularly to the wearer. More often, however, women's hats are a menace to society. Practically any woman is capable of spending most of her housekeeping money on any kind of weird structure of felt, feathers and foliage. And, Esmeralda says, she has left many a cinema after two hours of watching a hat bobbing up and down in front of her as a kind of barometer of its owner's synthetic emotions.

Now the hat has also become an aviation problem. Airline personnel hate women's hats with a unanimity that is rare among men. Some of the reasons are not very different from those why patrons of the opera, the ballet and the cinema hate women's hats. But there are others : the air hostess hates hats in big round boxes which don't fit in the luggage hold, large delicate hats that cannot be stowed anywhere without being crushed, hats with feathers that tickle other passengers. Ground hostesses hate to run after and retrieve hats with a high lift coefficient that get blown off their wearers' heads when the 'plane takes off. And pilots, co-pilots, navigators and grease monkeys hate women's hats out of sympathy.

Americans are known as go-getters. It now appears—according to the "Daily Mail"—that American airlines have gone to London to get new hats for their customers. Five special aviation models have been developed by a British hat designer, five models that can be crushed, packed in or under shoes, dresses and suits and still look as fresh as daisies when taken out after flying half-way around the world. What is more, they are convertible from a wind-resisting travel hat into a glamorous cocktail beret or—reports the "Daily Mail"—a bejewelled mink fez.

So far, so good—if you like bejewelled mink fezes. Esmeralda thinks fezes, minks and jewels are entirely different things and hardly seem to harmonize. Anyway, she says she's never seen a bejewelled mink fez and wouldn't like to be caught dead in one. She concedes that American ladies' hats are not frightfully attractive. She also agrees that English men's hats are probably the best in the world. But it is her considered opinion that English ladies' hats are the utter end, from the expensive freaks adorning England's crowned heads to the inexpensive oddities gracing the noggins of the men-in-the-streets' wives. The only hats that were worse, Esmeralda has been told by someone who should know, were the successive, only slightly revised versions of a stork's nest worn for decades before World War I by the German Crown Prince's wife at Potsdam. The only ones that are worse to-day are the things the Zulus put on their heads as part of the preparations for their war dances.

Which brings Esmeralda to the cardinal question. Why, she asks, didn't those American airlines fly two-hundred-and-five miles, or three-quarters of an hour, farther, and order their hats—in Paris ?

Girls in Uniform

While the airlines thus try to improve the accoutrements of their clients, it seems that some passengers, too, have grouses against the attire of the airlines' own personnel. The difference is, of course, that passengers think they don't have to be polite about showing their dislikes.

There was the case of a lady passenger who was due to leave Northolt Airport, London, for Hamburg in the middle of July. Courteously she was received at the airport building by Receptionist Jill Rogers. But instead of repaying one kindness with another, the lady—all feminine air travellers are ladies, of course—started calling the astounded Jill every name in Darwin's theory of evolution. She also scratched and bit her and smacked her face with her passport. When Miss Bridget Humble-Crofts, the senior receptionist, arrived on the scene, she was given similar treatment, except that by then the lady had adopted boxing tactics and landed several well-aimed punches on Bridget's delicate nose. At the same time she loudly proclaimed, "I like the Russians." Finally she was overpowered by a London policeman.

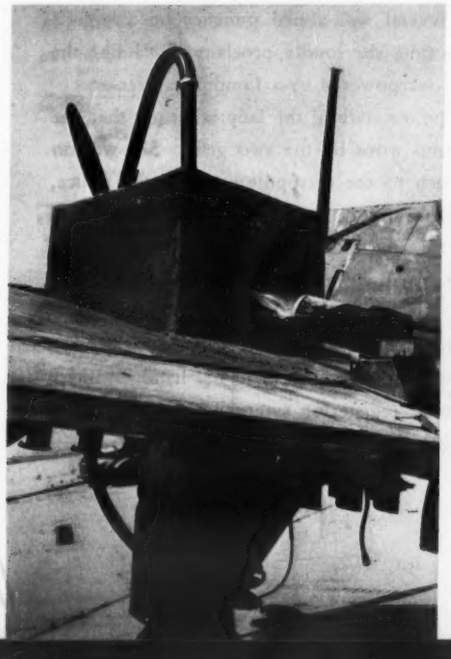
Duly interrogated at the police station, the lady admitted that she simply hated the grey uniforms worn by the two girls. She was no Russian spy, she stated, much to the disappointment of the police, but the Russians wore greenish uniforms and therefore she just loved them. Thus it is obvious that the lucky ones were the police—they are clad in navy blue—who narrowly escaped being knocked out by the irate passenger.

The whole business reminds Esmeralda of the story of the woman who went to see the doctor with a nasty gash in her hand. "Bitten by a dog ?" asked the doctor, registering sympathy. "Oh no," the patient replied indignantly, "it was another lady that bit me."

Progress in Pictures

The world's first airliner to be built specifically for jet propulsion, the de Havilland D.H. 106 "Comet" made its first flight on July 27th. Developed in under three years, its first public showing marked the end of a successfully-guarded secret. The "Comet" is a swept low-wing monoplane of dimensions similar to those of the DC-6 and "Constellation," and accommodates 36 passengers. Four de Havilland "Ghost" turbojets, semi-buried in the thin wing, give the "Comet" a cruising speed of about 500 m.p.h. at 40,000 ft., signifying a Europe—U.S.A. crossing in six hours. It is understandable, therefore, if B.O.A.C., which has ordered 14 units, expects to offer considerably improved services by 1952.—The photo shows, from left to right: Major Frank Halford, Technical Director, de Havilland Engine Co.; Air Commodore Sir Frank Whittle, Britain's jet-engine pioneer, who, at last year's general meeting of IATA, pointed out the need for improved airport traffic control before jet airliners could be used; Sir Geoffrey de Havilland; C. C. Walker, Chief Engineer, de Havilland Aircraft Co.

Even the smallest step towards an increase in safety can, in an emergency, assume the greatest importance and decide the fate of many human lives. When civil aviation is the victim of a "black series"—as it has been in recent months—the public, under the influence of sensational press reports, is apt to believe that gross negligence must pervade the aircraft factories. Nothing could be further from the truth. The greater part of the experimental departments of all aircraft firms—not to speak of specialist firms—is constantly endeavouring to increase the safety of every individual component, however small, of aircraft. For example, fire is dreaded more than anything else by aviators. For decades it has been tried—and with great success—to minimise this danger. Nowadays there is practically no aircraft, and certainly no commercial transport aircraft, which is not equipped with an elaborate fire warning and extinguishing system, capable of meeting any form of outbreak. These systems always work efficiently ... except when a fuel tank leaks and reanimates the fire. The B. F. Goodrich Company, of Akron, has now discovered a fire-resisting, flexible coating which can be applied with a brush to flexible fuel cells or any kind of fuel tank. In order to attract enough interest—what reporter would budge otherwise!—B.F.G. built a tank, treated in this manner, into the port wing of an old aircraft (the starboard wing of which contained an ordinary, untreated tank), and applied intense heat to both wings. The new product spoke for itself—a new step forwards which may help many a pilot to save himself and his payload from a burning aircraft.



A good aircraft is invariably followed by a number of more advanced versions. The long series of versions which evolved during the war from the Spitfire, Hurricane, Boeing B-17, or Me 109 have almost been forgotten. Sometimes the final product had little left in common with the original design. The fuselage was sawn apart, lengthened, shortened, widened or narrowed ; guns were multiplied, re-arranged or complemented ; engines were boosted or changed ; wings were braced, reinforced, fitted with tip tanks, or swept back. In this way the Lockheed F-80 "Shooting Star" single-seat jet fighter has given birth to the two-seat F-94 all-weather and night fighter, 100 units of which have been ordered by the U.S. Air Force. The elongated nose portion houses radar and guns, the centre portion contains an enlarged cockpit and an Allison J-33 turbo-jet, and the tail portion carries the jet pipe with afterburner for increased thrust.

Until lately the Americans have not devoted much attention to propeller-turbines. Up to two years ago it seemed that the American engineers—at least in this domain—did not take their British colleagues quite seriously. Indeed, the U.S. aero engine industry appeared to be interested only in pure jets—regardless of the danger that it might not be able to compete with the coming British airliners. The present photo, meanwhile, proves the contrary : development engineers of the Hamilton Standard propeller division of United Aircraft Corp. watch the installation of the firm's newest propeller, the "Turbo-Hydromatic," designed for use with gas turbines. The regulating conditions are very different from those of reciprocating engines and so far only few firms—*e.g.*, Rotol in England—have had any experience with them.

America's Air Navy of the Future

BY ANSEL EDWARD TALBERT

We present our new editorial associate, Ansel Edward Talbert. *During World War II he was one of the seven Army Air Force Officers who graduated from the U.S. Advanced Naval Intelligence School. Lieutenant-Colonel in the U.S.A.A.F., he was attached to the American Embassy in London and later to Headquarters, Eighth Air Force in England, as an air intelligence officer. Talbert is President of the Aviation Writers' Association o North America.* — Ed.

The United States Navy at present is pushing to completion the most revolutionary reorganisation of its 174-year-old history.

The reorganization is based on lessons of World War II and new weapons the conflict produced. Its goal is the creation of a powerful atomic-age Navy of global scope. This will center around highly-mobile Fast Carrier Task Forces, each capable of concentrating 1,000 or more jet-propelled aircraft in strikes against enemy land or sea targets, and also around groups of long-range schnorkel submarines able to launch swarms of pilotless guided missiles towards the same destination.

The core of United States Navy strategy is exploitation of the offensive and defensive potentialities of the seven-tenths of the earth's surface covered by water, in the present disturbed era of air power and atom bombs. While the United States Air Force is attempting to bring into being a long-range bomber force that could attack any point in the Northern Hemisphere successfully from fixed bases on the North American continent, the United States Navy is working on a different approach.

Its chiefs are planning ways of bringing concentrations of medium-ranged but very-high-speed planes and missiles to temporary operating points relatively close to the enemy targets in any future war—and then moving them back to safety when their mission has been accomplished.

Captain E. M. Eller, one of the Navy's most articulate spokesmen, has stated that in the event of war his Service would attack enemy manufacturing facilities, submarine pens, airfields and other vital centres "with all its power by moving aircraft carriers and missile-launching submarines undetected near to the enemy coast from unexpected places."

Although the last conference dealing with overall strategy of America's Army, Navy and Air Force heads assigned strategic bombardment of enemy industry to the Air Force for its primary mission, the Navy also received permission to conduct bombardment of land objectives. Its chiefs stated that they might be unable to keep open the sea lanes effectively unless this were allowed.

The Navy's bombardment plans for the future required some modification after the building of a projected Navy 65,000-ton super aircraft carrier was cancelled suddenly earlier this year by the new Secretary of Defence, Louis Johnson. He felt that the funds necessary for building the giant carrier could be used to better advantage elsewhere. This most certainly was a blow to Navy hopes.

But instead of destroying the Navy's ideas of how a future war should be fought, the move actually appears to have provided a strong incentive for aircraft designers working on Navy projects to produce new planes of superior performance which can be operated from existing Navy carriers.

Navy strategists, in connection with the super carrier, were thinking in terms of 100,000-pound jet bombers with combat radii of action of 1,000 to 1,500 miles and speeds of better than 500 miles an hour.

The reason was no secret. Navy planners such as Vice Admiral H. W. Hill estimated and stated publicly that 92 per cent. of the targets of any importance in the world were located within 1,200 miles of salt water.

Designers are now attempting to turn out a 65,000-pound bomber with a performance approaching that of the 100,000-pound air-

Warming up during a snowstorm between Labrador and Greenland.

Snow-covered wing of a Chance-Vought F4U-4 "Corsair" fighter.

craft for offensive operations from America's 45,000 to 50,000-ton carriers of the existing "Midway" class. First there will be strengthening and other modifications of the carrier's flight decks.

Meanwhile, in the Arctic, where the Navy already has conducted post-war experiments with carriers, Navy long-range patrol bombers are carrying out mapping and other cold-weather activities. Rear Admiral Robert O. Glover, chief of the Hydrographic Office, reiterates views of the other Services that "in the event of future global war, the Arctic regions will attain strategic importance never before associated with those areas."

The Navy has the advantage of cold-weather flight testing in the Antartic as well. Navy submarines and surface ships testing methods of launching guided missiles are at sea; and at such centres as Inyokern and Point Mugu in California, supersonic rockets and planes are flashing through the skies each day.

A former United States Secretary of War charged in his recent memoirs that chiefs of the Navy too often appeared to consider themselves as "high priests of a dim religious world in which Neptune is god, Admiral Alfred Thayer Mahan his prophet, and the United States Navy the only true church".

If this description ever was true, recent pronouncements of air-power-conscious Navy chiefs would seem to indicate that the old concept had been dumped overboard. Admiral Louis Denfeld, chief of Naval Operations, is authority for the statement that "the offensive power of the Navy is measured by the strength of Naval Aviation."

Opponents of sea-borne air power in the past have charged that aircraft carriers are highly vulnerable to land-based air power. However, the combat record of the Navy in the Pacific war offers little support for this idea.

Of 110 aircraft carriers of all types operated by the Navy during World War II, eleven were lost to enemy action. Of these only five were fast, first-line carriers. Two of the first-line carriers were sunk by Japanese submarines and three by Japanese carrier-based aircraft. None was sunk by land-based aircraft.

Only one first-line Navy carrier was lost after 1942. This appears to be of some significance, because during 1943 the Navy began to receive sufficient carriers to permit concentrations of more than 300 fighter aircraft at a single point. During 1944 mobile concentrations of up to 1,000 carrier-borne aircraft from Fast Carrier Task Forces became standards in offensive operations, and there is no instance on record where Navy air failed to gain command of the skies at the required time and place.

In addition to the Arctic, the U.S. Navy has also mapped the Antarctic from the air. Here is a Douglas R4D, fitted with ski landing gear, coming in for a landing at "Little America."

The records of enemy aircraft losses are equally revealing. Carrier-borne Navy aircraft of the United States destroyed *12,268* Japanese planes of all types during the Pacific War, in aerial combat and on the ground, according to final official Navy records.

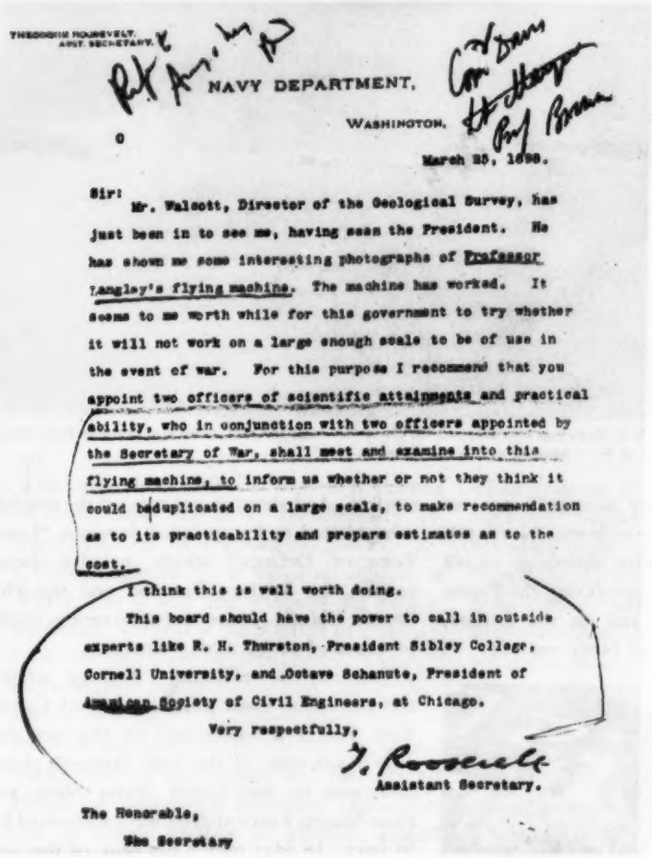
U.S. Navy ordnance crew installing offensive rocket missiles beneath the wing of a carrier-borne fighter.

Of the planes destroyed by United States carrier aircraft, approximately 93 per cent. were Japanese land-based planes and only 7 per cent. were aircraft based aboard Japanese carriers. And about 72 per cent. of the number were blasted in the so-called Japanese "Inner Zone of Defence" which included Japan proper, the Ryukus, Formosa and the Philippine Islands, where aircraft carriers might be expected to be most vulnerable.

The obvious efficiency of large aircraft concentrations made possible by Fast Carrier Task Forces is underlined by the fact that only 7 per cent. of the total Japanese planes destroyed by the United States Navy and Fleet Marine Force aircraft were accounted for in 1942. In 1943 only 9 per cent. of the total were shot down or destroyed on the ground. But 84 per cent. were destroyed during 1944 and 1945, when Fast Carrier Task Forces really began operating.

Carrier-borne Navy air was successful in overwhelming Japanese air garrisons on such major fortresses as Formosa and the Philippines. It is not always recognized that Allied troops who stormed the beaches at Leyte during the invasion of the Philippines went ashore exclusively under cover of an umbrella of air cover from Navy carriers,

The U.S. Navy's huge 82½-ton flying-boat, the "Caroline Mars," shown moored to a portable floating rubber dock which facilitates refuelling, loading and unloading of cargo and personnel at advanced bases.



THEODORE ROOSEVELT,
ASST. SECRETARY.

NAVY DEPARTMENT,

WASHINGTON.

March 25, 1898.

Sir:

Mr. Walcott, Director of the Geological Survey, has just been in to see me, having seen the President. He has shown me some interesting photographs of Professor Langley's flying machine. The machine has worked. It seems to me worth while for this government to try whether it will not work on a large enough scale to be of use in the event of war. For this purpose I recommend that you appoint two officers of scientific attainments and practical ability, who in conjunction with two officers appointed by the Secretary of War, shall meet and examine into this flying machine, to inform us whether or not they think it could be duplicated on a large scale, to make recommendation as to its practicability and prepare estimates as to the cost.

I think this is well worth doing.

This board should have the power to call in outside experts like R. H. Thurston, President Sibley College, Cornell University, and Octave Schanute, President of American Society of Civil Engineers, at Chicago.

Very respectfully,

T. Roosevelt
Assistant Secretary.

The Honorable,
The Secretary

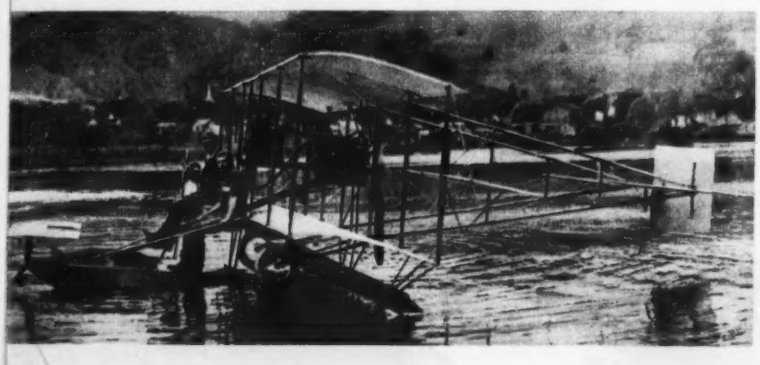
With this letter of March 25, 1898, Theodore Roosevelt, then Assistant Secretary of the Navy and later President of the U.S.A., urged the U.S. Navy to assess the military possibilities offered by Professor Langley's "flying machine."

just as Allied troops invading Normandy did so under cover by Allied land-based planes.

When General Douglas MacArthur's staff drew up plans for the invasion, it was found that the Leyte beaches were outside the range of Allied land-based air support. Therefore, just prior to the invasion date of October 20, 1944, Fast Carrier Task Force 38 was sent to the area. The intense bombardment of Japanese air installations by this force, accompanied by fighter sweeps, gained air superiority before the invasion.

The largest massing of Naval assault shipping concentrated up to that date in the Pacific war sailed almost unopposed into Leyte Gulf. General MacArthur was able to send ashore in the Philippines the Sixth United States Army, two corps and four divisions abreast, and make good his promise : "I shall return."

Yesterday : A U.S. Navy amphibian of 37 years ago—in fact, half the U.S. Navy air arm in 1911, when the first Curtiss "Triad" was purchased.



American land-based fighters did not commence operations from Tacloban Airfield on Leyte Island until October 27, 1944, and by October 31 only thirty-four P-38s had reached the airfield. Carrier-based aircraft destroyed more than *200* Japanese planes in aerial combat while providing air cover between October 20 and 29 for the entire invasion.

On other occasions in the Pacific, Navy carrier-borne aircraft attacked strategic targets in Japan proper. They provided air cover for amphibious assaults to obtain island bases such as Saipan and Iwo Jima from which heavy B-29 bomber units of the Army Air Forces later operated.

Fast Carrier Task Forces of the future, based on experiences of the last war, would consist of several Task Groups, each built around four first-line aircraft carriers with successive rings of surface elements to serve as protection from enemy submarine and air attack.

Experts on defence against atomic attack usually have found that dispersion provides the best answer to the problem. It is worth noting that the distance separating Task Groups in a Task Force is from twelve to fifteen miles. Navy strategists are certain that, in the event of an atomic attack by a determined enemy, only minutes would be required for a Fast Carrier Task Force to disperse so completely that at most only a few ships would be lost.

Vice Admiral Arthur W. Radford paints a vivid picture of what modern Fast Carrier Task Forces could accomplish. He states :

"In them we have the supreme embodiment of the cunning warrior. Without warning a Fast Carrier Task Force could appear over the horizon and unleash a devastating 1,000 plane attack. After hurling its thunderbolts this same force could disappear swiftly before the enemy could rally enough forces for a counter-attack. Within twenty-four hours such a force could be anywhere within a radius of 600 miles, within a circle having an area of over 1,000,000 square miles. An enemy could locate six needles in as many haystacks as readily as he could find that striking force."

Guided missile operations receive a similar theoretical analysis by Rear Admiral Dan V. Gallery, who says : "Until the era of true push-button warfare arrives, the Navy stands ready to endow any short or medium-range missile with 5,000 miles of extra range by firing it from a ship, a submarine, or a Navy aircraft."

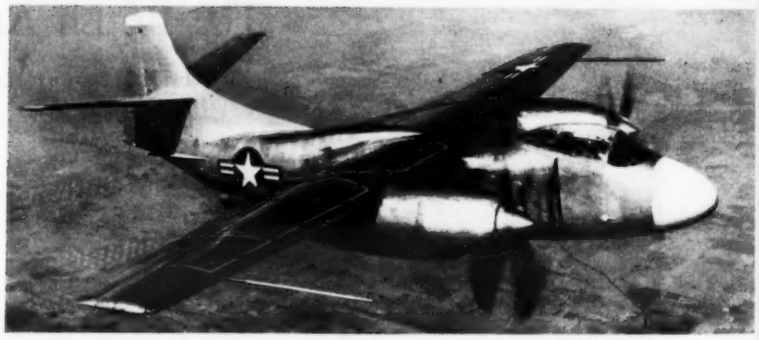
Fast Carrier Task Forces can remain at sea for up to three months without returning to port and the Navy is at present making exhaustive logistical studies of possible ways of bringing in particularly vital supplies in giant seaplanes. These would land in the open sea under favourable conditions or use portable rubber docks developed by Navy technicians for employment at advanced bases. Similar methods would be applicable to undersea groups of missile-launching submarines.

The Navy has been accused by its critics of "embracing air power today with all the fervour of a recent convert," but in the light of historical evidence this seems unfair.

Navy officials first expressed interest in aircraft more than fifty-one years ago. On March 25, 1898, Theodore Roosevelt, then Assistant Secretary of the Navy and later President of the United States, suggested in a letter to the Navy Secretary, John D. Long, that the Government investigate the military and naval possibilities of Dr. Samuel P. Langley's "flying machine."

The real birth of United States Navy aviation took place, however, on May 8, 1911, when the Navy Department placed an order for two aircraft with the Curtiss Company of Hammondsport, N.Y. The planes involved were Curtiss "Triads"—one a landplane and the other an amphibian of sorts with retractable wheels and a pontoon. Commander Theodore C. Ellyson, the Navy's first qualified aviator, who was taught to fly by Glenn Curtiss, tested both airplanes, approved their acceptance and later taught Admiral John H. Towers, then an

Today : This new high-speed, twin-jet fighter, the XF3D, was built for the U.S. Navy's carrier ships by Douglas Aircraft Co. An all-weather aircraft, it possesses, among many noteworthy features, a novel method of emergency escape, whereby crew members bail out by sliding down a chute giving on to the underside of the fuselage.



The U.S. Navy has announced officially that the AJ-1, powered with two Pratt & Whitney "Wasp Major" reciprocating engines and one additional General Electric/ Allison turbojet in the tail of the fuselage, is capable of carrying the atom bomb and of operating from present Navy carriers.

ensign, to fly as his own first pupil. Admiral Towers later became chief of the Navy Bureau of Aeronautics.

Among later accomplishments of Navy aviation was the first crossing of the North Atlantic by airplane. On May 16, 1919, the Navy flying-boat NC-4 took off from Newfoundland and on May 27, 1919, it landed in the waters off Portugal after a stop in the Azores. This was a few weeks before the British flyers Alcock and Brown made the first non-stop crossing.

Christopher Columbus II

Just a vagabond ; a vagrant without passport ; a law unto himself. The ground is his pillow, the sky his roof ; his fancy marks the spot.

Yet he has flown the Atlantic ; flown it several times, in fact.

His name ? No one can tell you, for no one, not even he himself, knows who was his father. But his deeds have earned him a name ; a famous name. Justly, he is called Christopher Columbus The Second !

You might expect to find him haughty ; strutting about like some gypsy prince.

No ! He's just a dog. And if by chance you spot him exchanging (unroyal) courtesies with others of his species at Orly Airport, and you call to him, the chances are he will not even realise it is in him you are interested.

Without pomp or ceremony, he has simply "chosen liberty."

Why at Orly ? Well, you see . . . the reason is simple . . . he likes aviation. There are, of course, other attractions there—as for instance, the tasty scraps he retrieves from the back doors of Air France's kitchens ; just like many other dogs do. But where this globe-trotting tail-wagger differs from ordinary canines is when the aircraft roar in to a landing ; instead of running away, this particular quadruped actually makes a beeline for them.

DC-4s, "Languedocs," DC-6s . . . fine ; but when it comes to seeing a Borzoi about a Cossack, there's nothing he prefers to a "Constellation." Sympathy pours from him as he raises his paw in salute.

Many are the kicks aimed at him by the mechanics. But if he scurries away howling, you may be sure he'll be back ten seconds later, to bestow his attentions on a landing wheel or maybe the portable entrance steps.

There's no getting away from it. This dog loves aviation.

But this strange love of a strange canine has not alone sufficed to justify his mention in *Interavia*. It is the fact that he has translated this love into exploits of rare derring-do.

He has flown to America and back !

No one knows by what prodigious feat he managed to stow himself inside an Air France "Constellation." Just after the "Fasten Seat Belts" sign had flashed off, he nonchalantly began wandering along the aisle. Delighted to find this novel distraction, the passengers stuffed him with dainty morsels and christened him Christopher Colombus II.

Alas, Christopher's seventh heaven was to come to an abrupt end. Hardly had he finished digesting than the aircraft landed at New York.

Not even for the now legitimate bearer of an illustrious name—visiting the country his namesake discovered—was an exception made. No passport ! No visa ! Forty-eight hours of quarantine was the welcome given him. And then, by force and at the end of a leash, back on to a long-distance transport bound for France.

For a few days after his return to Orly, he was a hero. People spoke of him enthusiastically. And then he was forgotten, as he effaced himself amidst the others of his species.

Until the day he flew again !

Again on an Air France "Constellation" bound for New York !

How he does it is his own secret. No one has so far succeeded in discovering it.

To date he has made six crossings.

*

If your travels take you to Orly, and you wish to find Christopher, you may have some difficulty. It is doubtful whether you can distinguish him from the other dogs cluttering the airport. Perhaps if you ask one of the local employees, he can help you.

There is really only one sure way of finding him. When a "Constellation" comes in, Look to Lockheed for . . . Christopher ! *G. F.*

The British Aircraft Industry

BY C. G. GREY, LONDON. (PART IV)

The Story of the Gloster Company

None of the historic firms which were united in the Hawker Siddeley combine has had a more interesting and in some ways eccentric history than has the Gloster Aircraft Co. Ltd., whose head offices and works are now at Hucclecote, which is about equidistant from either the city of Gloucester or the health resort of Cheltenham.

The firm originated as an off-shoot of a well-known Cheltenham business, H. H. Martyn & Co. Ltd. The works of Martyn & Co. were particularly well suited to make aircraft and their parts. Primarily they made interior fixtures for ships, and they had done the whole of the cabin arrangement and equipment for some of our most historic liners. At the moment I cannot remember their names, but I remember the beautiful workmanship that was turned out. They had all the first-class experience a first-class workman needed for fine metalwork and fine woodwork for first-class aircraft.

But apart from that Martyn & Co. did a high-class business in memorial tablets and plaques, and tombstones and "necropolitan" furniture generally. I remember particularly that when one drove through the gates to the offices one was met by two rather more than life-size stone soldiers with their rifles at the "ready." They must have been carved for a South African War Memorial or one of our assorted Indian affairs, and they probably came in very well for a War Memorial after 1918.

The moving spirit in H. H. Martyn & Co. Ltd. was Mr. A. W. Martyn, son of the founder of the firm, and Mr. David Longden, who were joint Managing Directors. Mr. Hugh Burroughes was also a Director and is today the sole survivor of the Martyn connection, and he is a Director of The Hawker Siddeley Combine. He is also a Director of A. W. Hawksley Ltd., an associated firm which has huge new works alongside the existing Gloster works at Hucclecote. The name is made up of Armstrong-Whitworth-Hawker and Siddeley.

1921-23: The Gloster "Mars I" ("Bamel") won many air races and established an official world air speed record of 212.5 m.p.h. on October 4th, 1922.

1929: The Gloster "Gnatsnapper," a deck-flying fighter for the Fleet Air Arm. Power plant was either a Bristol "Mercury" or an Armstrong-Siddeley "Jaguar VIII."

During the early part of the war 1914/18 the Martyn firm made various aeroplanes to other people's designs; including, at the end of the war, the Nieuport "Nighthawk," a fighter which, just too late in 1918, was designed for the British Nieuport Company which belonged to Sir Sam Waring of Waring & Gillow, who afterwards became Lord Waring. The "Nighthawk" had been designed by H. P. Folland, who had been assistant chief designer at the Royal Aircraft Factory at Farnborough, and had designed one of our best fighters, the S. E. single-seat fighter, which was why he was bought by Waring.

After the war Waring packed up his various aircraft interests and retired with his peerage and a fortune. In 1920, when Martyn's had decided to build aeroplanes to their own design, Folland joined them as Chief Engineer and Designer. At the Gloucester Co. he rejoined his old colleague Hugh Burroughes, who had been a technical assistant at the Royal Aircraft Factory from 1909 to 1913, and from 1914 to 1919 a Director of the Aircraft Manufacturing Co. Ltd., the great firm formed by George Holt Thomas, whence the famous D.H. series originated.

The first Gloucester success was a single-seater called the "Mars I," with a Napier "Lion" engine. A special racing version of it had a curious hump on top of the fuselage, so it was known as the "Bamel," because somebody suggested that it looked like a cross between a Bear and a Camel.

This machine won the Aerial Derby in 1921 and 1922, and put up two International Speed Records, one of 196.6 m.p.h., which it later improved to 212.15 m.p.h.—a record which stood for something like five years. The machine was somewhat re-designed and re-constructed in 1923 and won the Aerial Derby for a third time.

After that followed a series of single-seat fighters with various makes of engine. These were various types of "Mars" up to the Mark VI. Then came the "Grebe" and the "Grouse." In 1924 Folland designed the Gloster II, a seaplane racer designed to compete in the race for the Schneider Trophy.

Up to this time the firm was known as the Gloucestershire Aircraft Co. Ltd., but foreign buyers, or prospective buyers, found so much difficulty in pronouncing the name that the firm changed it officially to The Gloster Aircraft Co. Ltd., with which hardly anybody could make a mistake.

Folland designed a wonderful variety of types, mostly single-seat fighters, but he also produced a twin-engined air-survey machine which actually did good photographic work in South Africa. Another praiseworthy attempt was a huge four-engined transport machine, which, like a good many of his designs, was so much in front of the time that nobody wanted a machine of that particular type. His Schneider Trophy machines up to the Gloster Mark VI of 1929, which put up a speed record of 336 m.p.h., with floats, were fine designs, but the engines he had never quite gave the power that was needed to win.

About 1930 Mr. Francis Xavier McKenna was appointed General Manager and served the firm well through all the developments of the turbo-jet "Meteors" until he went into a well-earned retirement at the end of 1946.

Folland's last contribution to the Gloster Co. was the introduction of the multi-gun fighter. The first of these was called the S. S. 19. The armament consisted of two Vickers guns, carried in troughs one on

each side of the fuselage, synchronised to fire through the airscrew, and four Lewis guns mounted in the upper wing, two on each side and firing outside the radius of the airscrew. A total of only 1600 rounds of ammunition were carried, which works out at about 250 rounds per gun, or less than half a minute of firing if the pilot let them all off at once. Provision was made to carry four 20-lb. bombs. And for all this load the machine had a Bristol "Jupiter" engine which gave 480 H.P. at 9,000 feet.

We may note here that in 1927 The Steel Wing Co., which held pioneer patents of so far back as 1911 (under E. V. Sassoon) for the application of steel-strip to aircraft construction, was absorbed, and the development of this system was carried on by the Gloster Co. up to the last of the distinctively Folland designs—the "Gauntlet" and the "Gladiator," which were in production in 1938-39, until the beginning of the war. Both were of metal strip construction. A feature of the "Gladiator" was the single-leg undercarriage. The landing springs were in the hub of the wheels—a patent by George W. Dowty, then a draughtsman in the Gloster office.

Early in 1934 the Gloster Co. was taken over by Hawker Aircraft Ltd., and in 1936 the Hawker-Siddeley Group was formed, which absorbed Hawker and Gloster.

The "Gladiator" deserves a place in history because of the story of the defence of Malta. When the Navy and the Army evacuated Malta, under the threat of Italian-cum-German attack, a few R.A.F. people were left without any worthwhile fighting craft. Then one of them discovered, somewhere in the Naval area, three packing cases, each of which held a complete "Gladiator" of the type which was being supplied to the Navy, with deck-landing hooks and so forth.

These were hauled out and made fit to fly, and a series of R.A.F. pilots took turns in flying them. They were well up to the performance of any Italian aircraft that came over, so the three, which were nicknamed "Faith, Hope, and Charity," held off the Italian *Regia Aeronautica* till they were all shot to pieces except one, which is now, I believe, in a museum in Malta.

During the early years of the war the Gloster works, which were about the largest in England, were busy producing aircraft designed by other firms. Folland left in 1937 to become Managing and Technical Director of Folland Aircraft Ltd., of Southampton, taking with him H. D. Preston as Chief Designer and F. Radcliffe who had worked on all his Gloster designs.

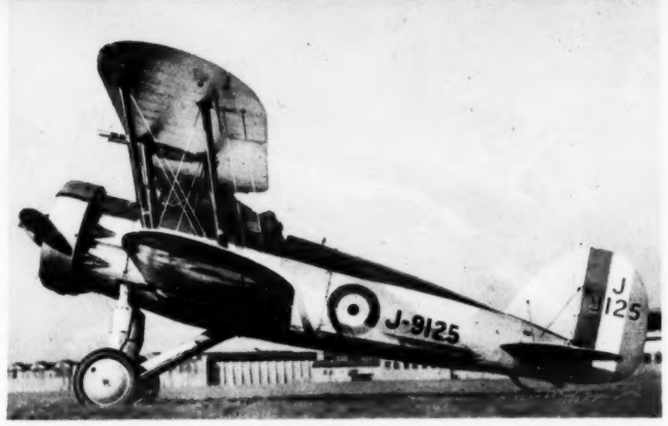
But thereafter the Gloster Co. was turned on by the Air Ministry to make the earliest of the Whittle turbo-jet machines. The Chief Designer was Mr. W. D. Carter, who had been in the Sopwith Co. in the old days. He has been responsible for all the Gloster "Meteor" designs. And the world knows how excellent they have been.

The first jet machine was flown by Gerry Sayers, who had been second pilot to George Bulman at Hawkers. He did all the experimental work when the chief defect of the jet was that it used to melt the blades of its turbine. I asked him what happened when it did so. He said, "Nothing. You just stop going places."—and proceeded to point out the advantage of a turbine which merely ceased to rotate as against a reciprocating engine which, if a connecting rod broke or a cylinder blew off, was liable to jump out of its housing and quite possibly wreck the aircraft.

Gerry Sayers was killed later on, but not in a jet machine. He was flying a fighter with another pilot, over the sea, and apparently the two collided in a cloud.

Since then various other pilots have been killed in jet machines through something in the engine blowing up and wrecking the machine. Unfortunately at the speed of jets there has been no chance until lately of getting out with a parachute. But now the ejector seat may save pilots.

Throughout the rest of the war the Gloster Co. went on developing the "Meteor" and during the last phase, when the R.A.F. was in



1932 : The Gloster S.S. 19, powered with a Bristol "Jupiter VII," was the first six-gun fighter.

1936 : The Gloster "Gladiator" single-seat fighter achieved fame in the defence of Malta.

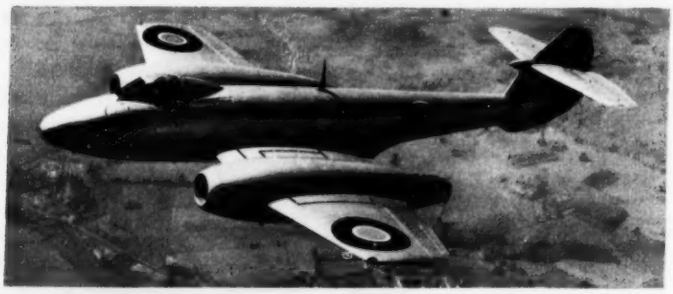
1941 : The earliest single-jet aircraft, the Gloster-Whittle E 28/39, was flown by Gerry Sayers.

Belgium, there were several squadrons of "Meteors" which were fully a match for any of the new German jet machines, except perhaps the rocket craft with a human pilot, which had a duration of only very few minutes in the air. Today the R.A.F. has many squadrons of "Meteors," and the Gloster Co. is turning them out on what is practically a war-time production line.

During the latter part of the war A. W. Hawksley Ltd. was producing quantities of aircraft material for the use of the Hawker-Siddeley Group generally. Since war-time production has been cut down the firm has made thousands of pre-fabricated houses which may be seen all over the country, and met on any of the main roads from Gloucester to any of the industrial centres. They also are up to the high standard of all the Hawker Siddeley Group products.

Another and very important component of the Hawker Siddeley Group is Air Service Training Ltd. It was founded by Sir John Siddeley with the idea of building up an Aeronautical College at which pupils would not only learn to fly but would learn to become first-class aeronautical engineers. The curriculum included flying training, training for the flight and ground engineers' certificate and the higher

Today: The "Meteor 7" two-seat training version of the famed "Meteor" twin-jet fighter; it can be fitted with radar and used as a night-fighter. Below is the modern "Meteor 4" clipped-wing type powered by Rolls-Royce "Derwent 5" turbo-jets.



Part of the varied fleet of Air Service Training Ltd. at Hamble, near Southampton.

theoretical training which would suit a man for the drawing office of an aircraft factory.

The underlying idea was to draw pupils from all countries which could possibly buy aircraft, and so indoctrinate them with a regard and respect for Armstrong-Siddeley products that when they went home they would not only be able to fly or to handle or to repair the Armstrong-Siddeley products which their country might buy but, having learned the excellence of those products on the spot, they would become permanent advocates of the buying of such aircraft or engines.

Sir John Siddeley chose as the Head of Air Service Training Ltd. Group Captain Robert Barton, O.B.E., who had been one of the right-hand men of Air Marshal Sir John Higgins when he was a Member of the Air Council. Later Sir John became a Director of the Armstrong-Siddeley Co., and was naturally made a Director of Air Service Training. The second in command of the school is Wing Commander H. F. Jenkins, O.B.E., who has also had vast experience of training.

From 1930 onwards the school attracted pupils from all over the world. During the war 1939/45 it was taken over by the Government, but Group Captain Barton was left in charge and given a lot of new instructors out of the R.A.F. Wing Commander Jenkins was in command of a night-landing training station elsewhere but as soon as the war was over he came back to A.S.T. and today it is if anything busier than ever. And naturally, as the Armstrong-Siddeley Combine makes so many different types of aeroplane, from the biggest bombers to the fastest jets, and as naturally products of all the Group firms are used for training at the school, the pupils get a vast variety of experience, not only in flying different types but in being able to study the construction of any aeroplanes they are ever likely to fly. Therefore, valuable as it is as a training school for pilots, it is becoming even more valuable as a school of experience for ground engineers, either Service or civilian. The pupils seem to come from all over the world with the exception of those countries behind the Iron Curtain.

Besides all these activities the Hawker Siddeley Group own High Duty Alloys Ltd., that firm which was founded by Mr. W. Devereux, which he owned from 1927 to 1945. It is particularly famous as making the special R. R. Alloys for Rolls-Royce aero and car engines.

So taking it all round you may see that the Hawker Siddeley Group, or Combine, can make and supply anything which has to do with aircraft, and teach people how to use it.

Official Bulletin of the F.A.I.

FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE, PARIS

Records homologated by the F.A.I.

CLASS C

Light aircraft (4 to 6.5 litres capacity)

Distance in a straight line (France)
Mme. Dupeyron
Morane-Saulnier 572 monoplane
Potez 4D-01 engine of 5.89 litres
Mont de Marsan to Jiwani (Baluchistan)
May 8th, 1949 *5,932 kms.*

Light aircraft (under 2 litres capacity)

Altitude (France)
René Leduc
Leduc aircraft
Zündapp engine of 1.988 litres
Nantes, June 13th, 1949 *7,788 metres*

Light aircraft classified according to gross weight

1st CATEGORY: under 500 kgs.

Altitude (France)
René Leduc
Leduc aircraft
Zündapp engine of 1.988 litres
Nantes, June 13th, 1949 *7,788 metres*

2nd CATEGORY: 500 to 1,000 kgs.

Altitude (France)
Mlle. Elisabeth Boselli
Piper "Cub" monoplane, F. WDTD (516.8 kgs.)
Mathis 4 GB 60 engine of 92 H.P.
Brétigny sur Orge,
May 21st, 1949 *5,791 metres*

WOMEN'S RECORDS — CLASS D

1st CATEGORY

Speed over 100-km. triangular course (Poland)
Miss Irena Kempowna
"Sep" No. SP-552 sailplane
Kiczera—Rownica—Pilsko—Kiczera
June 10th, 1949 *30 kms./hr.*

The Month in Review

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FIRST FLIGHTS

● The first production model of the Fairchild C-119 "Flying Boxcar," an enlarged and slightly modified version of the C-82 twin-engined twin-boom transport, has been flown in initial flight tests at the Hagerstown, Md., plant of Fairchild's aircraft division. It is powered by two Pratt & Whitney R-4360 "Wasp Major" radials of 3,250 H.P. each, whilst the C-82 has 2,100-H.P. engines of the R-2800 type. Fairchild has orders for 136 aircraft of the new type.

● The prototype of the Douglas "Super DC-3" twin-engined transport for 30 to 38 passengers took to the air for the first time on June 23rd, 1949, with John F. Martin, Douglas chief test pilot, at the controls.

Douglas "Super DC 3"

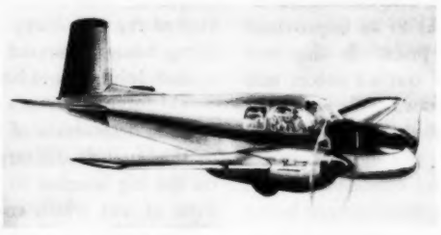
● The prototype of the Macchi M. B. 320 twin-engined light transport made its first flight from Venegono Airport (Varese) with Guido Carestiato, Macchi test pilot, in the cockpit. Known as the M. B. 314 during its design stage, the M. B. 320 is a low-wing monoplane of wooden construction, with single fin and rudder unit and retractable nose-wheel undercarriage. The cabin accommodates six passengers. Power is furnished by two Continental E 185 engines of 185 H.P. each.

NEW AIRCRAFT

● The latest version of the Republic "Thunderjet" single-jet fighter, the F-84E, is equipped with an Allison J-35-A-17 turbo-jet which delivers, with water injection, a thrust of over 6,000 lbs. As a result, the "Thunderjet's" maximum speed of 600 m.p.h. has now been increased substantially. Moreover, the radius of action, formerly of 600 miles, is now in excess of 850 miles, and the new version's service ceiling is set at above 45,000 ft. Armament for ground support and other purposes includes six 0.50-in. machine guns, eight 5.0-in. HVAR (high-velocity aircraft rockets), and a bomb load of up to 2,000 lbs. ; aircraft depth charges or incendiary bombs can also be carried. In addition to increased structural strength, the F-84E's fuselage is 15 in. longer in the nose section to allow more room for the pilot. Thanks to additional structural stiffening in the wing and empennage sections, the new version of the "Thunderjet" is now authorised for unlimited flying operations under full load conditions with wing-tip tanks. In cooperation with the U. S. National Advisory Committee for Aeronautics (NACA), Republic Aviation Corp. is also conducting tests with flush side inlet ducts instead of the conventional nose air intake of the standard F-84. The aim is to provide a fuselage nose giving space for housing radar equipment.

● Initial flight testing of the first Boeing B-50 "Superfortress" four-engined heavy bomber equipped with a track-tread undercarriage has been completed at the manufacturers' Seattle plant. It will be recalled that such tests were undertaken previously with the Fairchild C-82 "Packet" twin-engined freight transport ; such an undercarriage is now being developed even for the huge Convair B-36 six-engined long-range bomber.

● Beech Aircraft Corp. announces that it is working on a twin-engined aircraft to be designated Beech 50 "Twin Bonanza," an all-metal low-wing monoplane with conventional tail unit. The Beech 50 will be fitted with retractable undercarriage, the main wheels retracting into the engine nacelles. Two 185-H.P. Continental E 185 engines will power the machine, which is designed primarily as a five-seater but can accommodate six persons for short-range flights. Beech states that no further details of the aircraft will be announced until after the flight tests are completed. First deliveries of the Beech 50, priced according to present estimates at approximately $30,000, are not to be expected before early 1950.



Beech 50 "Twin Bonanza"

● Vickers-Armstrongs Ltd. announce that the second "Viscount" airliner will be fitted with two Rolls-Royce "Tay" jet engines. The first aircraft is equipped with four Rolls-Royce "Dart" propeller-turbines ; the third version is the "Viscount 700" which has four "Dart" propeller-turbines of the augmented-power version (1,420 S.H.P.), giving an increase in all-up weight and range. At present the "Tay-Viscount" is purely experimental, and will be used for airframe development in connection with high-speed and high-altitude flight.

● Avions Marcel Dassault, the French manufacturing concern, is developing a new jet aircraft, possibly as a successor to the Dassault MD 450 "Ouragan."

● The Arsenal VG 90 single-jet carrier-borne single-seat fighter structurally bears a close resemblance to the Arsenal VG 70 high-speed experimental jet aircraft. It features a swept wing (25 deg.), a single fin and rudder unit, and a retractable nose-wheel undercarriage ; arrester gear is provided for deck landings. Air intakes for the Rolls-Royce/Hispano "Nene" turbo-jet are in the wing roots. Fitted with complete radar equipment, the VG 90 is armed with three 30-mm. cannon and either two 1,100-lb. bombs or eight rocket projectiles. The wing span is 39 ft. 4½ in., length 42 ft. 9½ in., wing area 323 sq. ft., gross weight 17,860 lbs. (giving a wing loading of 55 lbs./sq. ft.) ; maximum speed is estimated at 597 m.p.h. at 20,000 ft., and the range is given at 1,500 miles.

Bréguet G 11E helicopter

● S. A. des Ateliers d'Aviation Louis Bréguet is presently subjecting its new G 11E single-engined helicopter to endurance tests. Equipped with two contra-rotating co-axial three-blade rotors and a fixed tail unit, the G 11E is expected to reveal a cruising speed of over 125 m.p.h.

AIR TRANSPORTATION

● The Instrument Landing System (ILS) and the Ground Controlled Approach (GCA) have been approved as standard landing aids for world-wide use by the International Civil Aviation Organization in Montreal.

● On June 24th, 1949, K.L.M. Royal Dutch Airlines made its 600th return flight from Amsterdam to New York. During the period up to that date, the company carried 30,000 passengers, 140 tons of mail, and 190 tons of freight on the trans-Atlantic line. On June 19th the company completed its 250th return flight to South America, over which route it has flown 3,728,000 miles, carrying 24,000 passengers, 47 tons of mail, and 850 tons of freight.

● Aero O/Y, the Finnish flag airline, is reported to be on the point of placing an order for two SAAB-90 "Scandia" twin-engined transports. An aircraft of this type was recently successfully tested over the line's domestic route network.

● The first of three Sud-Ouest SO 95 "Corse" twin-engined transports, ordered by Air Services of India, arrived at Bombay on June 17th, after a flight of 23 hours 45 minutes.

SERVICE AVIATION

● The Berlin Airlift completed the first year of operations on June 26th. During this period American and British aircraft flew a total of 1,952,660 tons of freight into Berlin on 236,290 flights.

● Following the conclusion of the factory flight test programme, the Consolidated Vultee XC-99 six-engined heavy transport has now been delivered to the U.S. Air Force's Seventh Bombardment Wing at Carswell Air Force Base in Texas.

North American F-86 "Sabre" jet fighters

● The First Fighter Group of the U.S. Air Force has now received its full quota of 83 North American F-86 "Sabre" jet fighters at Group Headquarters, March Air Force Base, Cal. The Fourth Fighter Group, based at Langley Field, Virginia, will be the next formation to be completely equipped with the "Sabre" and has already received several. As soon as the Fourth receives its full quota, the Air Force will have defensive tactical units equipped with "Sabres" in operation on each Coast.

● Fiat S. A., of Turin, has developed a special "flying classroom" with a 22-seat cabin, the G. 212 "Aula Volante," which is a modified version of the Fiat G. 212 CP three-engined passenger transport. Practically identical to the passenger version, the "Aula Volante" additionally features special instructional equipment for navigation, photographic and reconnaissance work. A special two-place gondola is fitted under the mid-fuselage belly. The aircraft has been developed to the order of the Italian Air Force College.

"Aula Volante"

* Excerpts from Nos. 1726-1746 (21st June to 19th July, 1949) of "Interavia Air Letter," an aeronautical digest published five times weekly, with photo supplement, in separate English and French editions.

Marginal Notes

Pax Americana

The men in Washington have been trying for months to clarify two problems ; two problems which, externally, have nothing to do with one another. But both are problems which reveal how great is the confusion into which the postwar era has plunged us. To this end the U.S. politicians have initiated so-called hearings—high-level quiz sessions of military and civil aviation experts.

Problem one, which is military in nature, culminates in the following consideration : Any new war would necessarily be intercontinental in scope. The Americans decided the last war thanks to an improvised arming of all Service branches ; but at a terrific price. In that war we were able to weaken our enemy by means of our air forces and drive him to his knees by conducting landing operations. We possessed the bases for these operations, or were able to seize them with relative ease. The next time ? If war were to break out, our most powerful ally of yesterday would now be our most powerful opponent. Thus the question of bases would be a tricky one. Is it therefore not better if, instead of trying to arm ourselves in all sectors to an extent which is, after all, beyond our means, we concentrate on a "superblitz" concept ?

Victory through air power

When the new U.S. Defence Secretary, Colonel Louis Johnson, decided a few weeks after taking office to make the U.S. Air Force really independent, place the weight of aerial armament on a strategic or bomber force, restrict the scope of the tactical or fighter forces, and finally to stifle the ambitions of the Naval air arm, he stepped into a hornets' nest. His opponents—including manufacturers whose contracts were slashed, Army, Navy and political people who disagreed with his concepts—accused him of lacking in objectivity, of rashness and ignorance.

He chose as the main air weapon Consolidated Vultee's B-36 six-engined (and in its latest version, ten-engined) heavy long-range bomber, and chance had it that Johnson belonged to the Convair Board of Directors before he took on his new appointment. Was he therefore a "five-percenter," one of those officials personally interested in contract awards ? Quite rightly, no one dared accuse him of this, for Johnson is an independent man financially, far too versed politically to become implicated in this way, and his record hitherto is so unblemished that such an accusation would have been ridiculed. Lacking in objectivity ? Hardly !

How about the question of rashness ? Discussions went on in Washington for about three years as to how the former Army Air Forces—which, as its name implies, was subordinated to the Army in the last war—could be made into an independent Service. Johnson simply endeavoured to settle this question, which was part of the reason for his unfortunate predecessor Forrestal's failure, with a stroke of the pen. He created an independent Air Force and, as he did not wish to have two air forces at his disposal, he restricted the responsibilities of the Naval air arm by cancelling plans for a 65,000-ton super aircraft carrier. In future the Naval air arm's role is to protect the fleet, thus an auxiliary arm. The independent Air Force ? In future, an instrument for punishing and destroying !

The chosen medium of punishment, the B-36 bomber, cruises at about 300 m.p.h., possesses a service ceiling of some 40,000 ft., a payload around 5,000 lbs., and a range of about 10,000 miles. Thus it is expected to be able to carry an A-bomb to any target in the northern hemisphere and return to its U.S. base of departure, and be more or less immune to attacks by fighters in view of its high-altitude capabilities and its 15-man crew.

But Johnson and the U.S. Air Force Staff are not so much concerned with a specific type of aircraft, which they know must be superceded one day, as with the laying down of future aerial warfare strategy. They simply made a decision of principle, in favour of an instrument which, they believe, will either win or—better still—prevent a future war, and thus secure a "Pax Americana."

In the June 25th issue of *The Saturday Evening Post* America's "Flying Admiral," Rear-Admiral Dan V. Gallery, who is Assistant Chief of Staff of the U.S. Navy for guided missiles and a veteran of over 5,000 flying hours, delivered a heavy but not necessarily hopeful broadside against Johnson and his disciples : Johnson's blitz theory, he contends, would leave America's friends in the lurch, provide only for weapons of mass destruction of a whole population and not for the destruction of the enemy's military forces, gamble with the future of the U.S.A. on the big bomber by neglecting the Army and Navy, and call for a form of war which ensures losing the peace even if the war is won.

The answer to problem one ? In principle it has been decided, at least temporarily : the superblitz !

Trade follows the flag

No longer does world trade follow Britain's Union Jack, but America's Stars and Stripes. No longer do ships alone carry this flag, but also the aircraft of America's new commercial fleet.

Month by month it is being expanded and improved ; already today it rules the world. But its owners, the U.S. airline companies, have difficult postwar years behind them and are struggling for a better future.

Recent statistics proved that commercial air transport within the U.S. frontiers is beginning to consolidate : the first four months of 1949 revealed a decrease in the revenues of first-class (Pullman) railroad traffic from $297 million to $285 million, and an increase in airline revenues from $66 million to $80 million. The difference is significant : air transport is on the up-grade and rail traffic on the down-grade.

But outside the U.S.A., in overseas air transport, a different situation prevails. There, three U.S. airline companies are competing among themselves, with non-American airlines, and with the shipping companies. And in this North-Atlantic herring pond a very enterprising and powerful fish is swimming about : Pan American World Airways. Before the war Pan Am practically monopolised U.S. overseas airline traffic. After the war they lost this monopoly ; but they are determined to regain it. If they obtain, before the end of the year, permission to take over one of their North-Atlantic competitors, American Overseas Airlines, then they will have moved nearer to their goal. Should they not receive this permission from Washington within reasonable time, they will have to bury their monopolistic ambitions, for the others will meanwhile have become stronger.

Memorandum after memorandum is being submitted to the competent authorities in Washington, in which Pan Am logically point out the millions of taxpayers' dollars that would be economised by such a unification in North-Atlantic civil aviation ; under no circumstance could their merger with A.O.A. harm the only remaining U.S. competitor on the North Atlantic, Trans World Airline. Nevertheless, the heads of Pan Am and T.W.A.—Juan T. Trippe and Ralph S. Damon —are not quite in agreement on this last point.

Hearings are still proceeding as these lines are being written. But has not this problem, too, been decided already ? How, otherwise, are we to interpret the fact that a personality of the calibre of General George C. Marshall entered Pan Am's Board of Directors last July ? . . .

X 4

Germany's Smallest Liquid Rocket

By Heinz Gartmann

German war-time rocket developments included, alongside the well-known V-2 and a large number of designs of different type and size, an extremely small liquid-propellant rocket motor. As rocket motors can be made neither larger nor smaller geometrically, unless all the relevant constructional data and values are changed, special attention is earned by the particular characteristics of this unit.

The growing strength of the Allied air forces caused the German Air Ministry in 1942 to start planning special guided missiles, among which the reaction-propelled winged missiles carried by fighter aircraft originally played a predominant rôle. The *X 4 rocket missile*, developed by a special group headed by Dr. Kramer, at first in cooperation with the Deutsche Versuchsanstalt für Luftfahrtforschung (D.V.L.) at Berlin-Adlershof, and later at the Ruhrstahl-Presswerk Brackwede, near Bielefeld, was built immediately after the " Fritz X " guided winged bomb.

The Bayerische Motorenwerke (B.M.W.) furnished the rocket motor for the X 4, the code designation being 109-548 (and occasionally P 3378). B.M.W.'s had been instructed to build a motor featuring a relatively high acceleration thrust and a low trip thrust ; the total impulse was prescribed, and the motor had to work regardless of rocket attitude and be resistant to accelerations. As it was clearly an expendable product, and could therefore not be used more than once, the construction had to be as simple and the manufacturing costs as low as possible.

B.M.W.'s rocket staff was used to working with nitric acid as oxidiser in propellant mixtures and had by then gathered a fair amount of experience with spontaneously ignitable mixtures of this type. The necessity of building from scratch all the structural components and manufacturing them for the tests, consumed a great deal of time and delayed the first tests of the 109-548 motor until late in 1943.

Structure

The stipulated total impulse of 1,600 kg-sec. and the given size of the rocket shell required that the constructors make the best possible use of the available space. The requirement of resistance to accelerations and independency of attitude, moreover, made it necessary to adopt a floating-piston design, as such a small and expendable engine could not have any fuel-feed system other than one working with compressed air. All the tests with normal, cylindrical tanks and light-alloy floating pistons failed because of the nitric acid's action of decomposing the lubricants and thereby causing a scuffing of the pistons. The spiral tank ultimately chosen for the propellants was a novelty in respect of rocket development and is a characteristic feature of the 109-548 rocket motor.

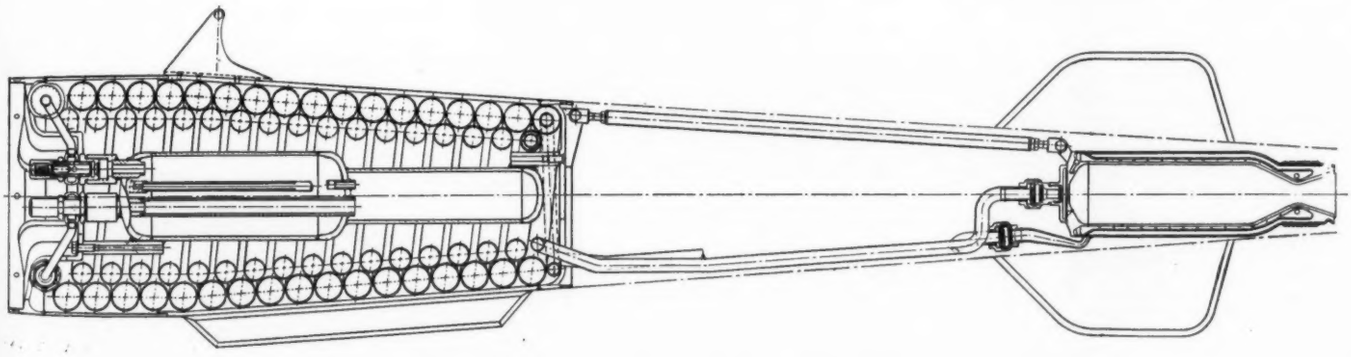
In the main this motor consisted of a combustion chamber, two spiral pipes serving as propellant tanks, a compressed-air container composed of two separate tanks, two valves for the air container, and a few accessories. In each of the propellant tanks there was a sort of stopper—a resilient floating piston made of a substance which resisted the fuel and oxidiser and prevented the compressed air from mixing with the propellants during the feeding process.

Function

The spiral pipes containing the propellants were sealed off at both ends by membranes of sheet aluminium. A small, resilient floating piston was located at the air-inlet side of each tank.

For the motor to be set in operation, membranes which were brazed on to the exits of the compressed-air containers had to be broken through. This was done, in conditions of absolute safety, by means of two electrically-ignited small-calibre cartridges. Then the outcoming air broke through the front tank membrane, placed the propellants under pressure ; these broke through the rear membrane and entered the combustion chamber where the combustion started spontaneously, furnishing maximum thrust immediately.

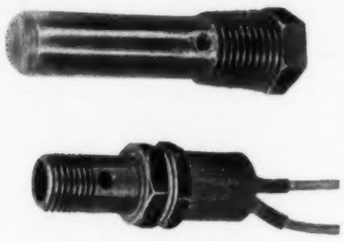
The requirement of high acceleration thrust and low trip thrust was met by having an impulse of 800 kg.-sec. delivered during the first eight seconds of operation and the remaining 800 kg.-sec. impulse distributed over the remaining period of operation, lasting for at least another eight seconds. This was accomplished, with a complete



Sectioned view of the 109-548 rocket motor for the X 4 guided missile. Outer winding : nitric acid ; inner winding : Tonka 250 ; enclosing the compressed-air container. Right : combustion chamber with cooling jacket.

Propulsive element of the X 4, without cowling, wings, warload, and control organs.

Spiral tanks for oxidiser (nitric acid) and fuel (Tonka 250).



Membrane valve for releasing compressed air.

absence of valves, by exploiting the adiabatic expansion in the compressed-air container and adjusting all influencing values, so that the motor delivered its thrust according to a preset programme, in which the peak thrust amounted to about four times the minimum thrust.

Compressed-air membrane with cartridge and electrical ignition.

Combustion unit

The limitation to one single "sortie" enabled cheap types of steel and sheet steel, not anti-corrosive, to be used for the combustion unit. Injector, combustion chamber, injector head, and cooling jacket were welded. The coolant inlet (coolant was nitric acid) being at the thrust-nozzle end required a double-walled jacket for the coolant flow. In the cooling space proper, ribs on the outer wall of the combustion chamber, which formed a two-way helical channel, facilitated the forced circulation cooling cycle.

In the injector head there were six ports for nitric acid and three for the fuel. Since experience had shown that, in the event of storage for some time, the small-diameter parts became stopped up by dirt or frozen up with condensation water when the device was sub-cooled, a series of special tests were conducted with synthetic fats for lubricating the sensitive ports. A composition was ultimately found which, in the required wide temperature range between +50 and — 50 deg. C., maintained a desirable combination of resistance and resilience. This fat, which received the designation of ZR 60, did not react with nitric acid. It remained unchanged between — 40 and +50 deg. C., and could be removed from the ports at a temperature of — 40 deg. C. and a pressure of 10 atmospheres.

Attempts to simplify the combustion unit through capacitive cooling were unsuccessful despite the short period of operation. The thermal stress on the combustion chamber is dependent, among other things, upon the pressure in the chamber, as the specific propellant consumption, and hence the combustion temperature, increase with the pressure within certain limits. If the injector ports are of constant diameter, this influence is amplified in that higher combustion-chamber pressure is accompanied by higher injection pressure, whereupon the efficiency of the combustion is improved.

Propellant tanks

The spiral-pipe tanks, together with the resilient floating pistons, were among the noteworthiest particularities of the 109-548 motor. They were manufactured, in one winding operation, from pantal-alloy tubing. Connecting parts and conduits to the combustion unit were welded on afterwards. The slight waste of space between the windings and compressed-air container was offset by the extremely cheap manufacturing process, which was of decisive importance in the choice of the combustion chamber. Frequently the high stresses arising at the beginning of operation initially caused breakages in the conduits and made special connecting parts necessary.

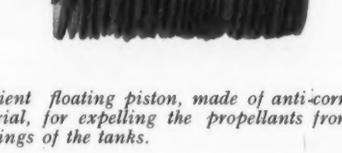
Combustion chamber with coolant jacket.

The floating pistons involved systems built up from small and larger discs placed one behind the other on a flexible core. Aluminium hemispheres at the front and rear ends improved the guidance and prevented the dreaded flow delays in the always somewhat irregular windings. The small pistons enabled complete expulsion of the liquids to be achieved, whereby neither the attitude nor the accelerated condition of the unit was of influence.

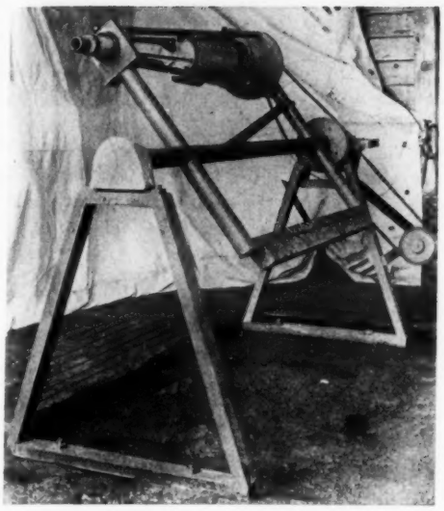
In such small rocket motors the shape of the tanks and the method of feeding the propellants are of decisive importance. There is a choice of at least five types: large, cylindrical, rigid pistons; differential, guided pistons; tilting pipes, resilient plastic inserts, and the spiral-pipe tank. Pistons, tilting pipes or inserts are invariably for separating the compressed air and the propellant mixture. In evaluating the various systems account should be taken of: the attainable ratio of weight to total impulse, the possible ratio of total volume to liquid volume, the temperature dependency, the C.G. shift as the tanks empty, the time and expense involved in the manufacture, and the developmental difficulties presented.

Operational data

In the first design the volume of the compressed-air container was chosen too large, but radical changes of entire components could not be undertaken in view of the invariably too short periods accorded for development. Consequently, the stipulated total impulse of 1,600 kg.-sec. could not be attained with the first constructions. During the passage to small serial manufacture towards the end of the development period, it was possible to improve the volume of this container by enlarging the diameter of the spiral pipes.



Resilient floating piston, made of anti-corrosive material, for expelling the propellants from the windings of the tanks.



Test bed for investigating the motor's resistance to accelerations and independency of attitude.

Data on the first test models :

Total impulse	1,100 to 1,200 kg.-sec.
Impulse over first 8 sec.	650 kg.-sec.
Thrust duration	17 to 19 sec.
Maximum thrust	approx. 100 kgs.
Empty motor with cowling	12.6 kgs.
Fuelled motor with cowling	20.5 kgs.
Cowling	5.2 kgs.
Overall length of motor	1,235 mm.
Maximum diameter	220 mm.
C.G. shift, maximum	59 mm.
Compressed air pressure	110 atm.
Operational temperature, admissible	+ 10 to — 40 deg. C.
Operational temperature, average	— 20 deg. C.
Propellants :	
nitric acid	6.3 kgs.
Tonka 250	1.6 kgs.

Tonka 250 was a fuel mixture composed of 50 volumes of triethylamine and 50 volumes of xylidine.

Data on the first serial models :

Total impulse	1,400 kg.-sec.
Impulse over first 8 sec.	800 kg.-sec.
Thrust duration	22 sec.
Maximum thrust	approx. 140 kgs.
Empty motor	14 kgs.
Fuelled motor	22.5 kgs.
Nitric acid	6.7 kgs.
Tonka 250	1.8 kgs.
Compressed air pressure	120 atm.
Specific propellant consumption	5.6 kgs./tonne.sec.
Combustion chamber pressure, maximum	approx. 30 atm.

Measurements of thrust and motion

The extremely sudden initial thrust, followed by several thrust oscillations until the gradual transition to the rapidly falling thrust process, caused the measuring instruments to deflect wildly. In consequence, a sprung type of suspension was devised as test bed for ascertaining whether noteworthy oscillatory and shock forces acted on the motor. The results of these measurements are of general interest since they contain basic data on the torques arising from the motion of the propellants in the spiral pipes.

The suspension was conceived so that the motor could oscillate freely in the horizontal and vertical planes and turn about its longitudinal axis. The oscillation being of 9 c/s frequency, the suspension was very soft. Thrust and motion were recorded by electrical instruments, and the resultant oscillograph diagrams of the thrust were particularly informative with respect to the processes between the putting of the engine into operation and the initiation of the combustion. It is therefore interesting to recall them in detail. At zero seconds the first small shock was recorded, together with an agitation in the motor. This shock was due to the piercing of the membrane sealing off the compressed air from the Tonka ; the agitation was a consequence of the compressed air flowing in. After 0.43 seconds there occurred another series of shocks as a result of the same process repeating on the nitric acid side of the motor. The delay between 0.4 and 0.5 seconds was intentionally governed by a relay, so achieving the desired entry of the fuel before the oxidiser —the only safe way of starting the combustion.

After a further 0.52 seconds the combustion chamber's coolant jacket was filled with nitric acid, so that this could now be injected into the chamber. The thrust began at this moment. After about 0.01 seconds it had reached its maximum value, later to drop in accordance with the expansion of the compressed air. Oscillations observed at the beginning of the combustion were due to the spring suspension, as was shown by shocks impressed upon the equipment.

Development

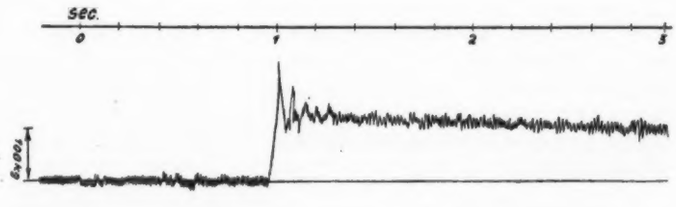
After test runs in refrigerated chambers and on rotating and centrifugal stands, the rocket was released, in the summer of 1944, for its first launching tests from the ground. Five successful and convincing launches were made on the proving ground at Bielefeld. Later, the rocket was launched from an aircraft. In ground-to-ground tests it reached a range of three kilometres, and in air-to-ground launches it travelled five kilometres.

The X 4 being launched from an aircraft. The electrical control impulses are transmitted along two thin wires.

It was first planned to fire the rocket from the Fw 190 fighter (which later proved too slow) with the X 4 connected to the aircraft by long electric wires for control purposes. Early doubts about this disturbance-free type of control were dispelled after unsatisfactory tests with a system using aneroids for constant-altitude control. Two wires were used, of 0.16 to 0.22 mm. thickness and some five kilometres in length. They were coated with lacquer for insulation, wound on to spools, and housed in tear-drop shaped containers fixed to the wing tips.

Four short, twisted wings, sharply swept back, caused the missile to rotate slowly. This rotation compensated eventual manufacturing irregularities, which could have prejudiced the accuracy of aim. Elevator and rudder, due to this rotation, continuously changed their respective functional positions, so that an automatic control switch-over device was built in to cope with this occurrence. Control impulses were sent out by the pilot through the medium of a lever working on the joystick principle, thus movable in all directions. A fuse in the nose of the X 4 reacted to aero engine noise and caused a 20-kilogram warload to explode at seven metres from the target. It was planned to fit four such missiles to each fighter.

The collapse of the Luftwaffe's fighter forces at the end of 1944 caused all X 4 operation plans to be cancelled. A last attempt to use this missile as a ground-to-ground anti-tank weapon was cut short when the manufacturing firm was destroyed by the Allies.



Oscillograph recording of thrust measured on the spring-suspended motor.

Problems of Fighter Interception

By Commandant COUTAUD, Paris

Until recent years a fighter interception manoeuvre consisted merely in directing one's own aircraft as rapidly as possible against the invader. The ground controller's task was over as soon as visual contact had been established. Then the aerial combat began, and completely escaped the control of the ground station. Thus the fighter interception manoeuvre was reduced to a simple geometrical problem and the accuracy of its solution seemed to depend only on such technical progress as provided improved aircraft detection and more rapid intervention—thus questions concerned with radar, communications, operational organisation, and so forth.

Since then, the progress made in aircraft design and the superior performance (speed and ceiling) which has gone with it, has added a new problem to the fighter interception manoeuvre, this time of a tactical nature. Beforehand, the ground station could regard the manoeuvre as successful once it had directed the fighters into visual contact with the enemy. But in those days fighters were extremely manoeuvrable aircraft which operated at moderate speeds and seldom at altitudes of more than 26,000 feet, and which possessed a speed advantage over bombers, especially heavy ones, of well over a hundred miles per hour. Thanks to this the fighter aircraft, once it had established visual contact with the enemy, could rapidly climb to a favourable altitude for the attack, all without losing sight of the target.

Today's conditions are different. Even heavy bombers can reach altitudes of 40,000 feet, and power plants involving combinations of reciprocating and turbojet engines endow them with speeds close to 400 m.p.h.—which can be increased over short periods by means of rocket motors. The medium bomber, powered exclusively by turbojets, is practically on a par with the fighter as regards speed. Because of compressibility effects in the vicinity of sonic speed the fighter is gradually losing its superiority in respect of speed, and at great altitudes it also loses much of the manoeuvrability that erstwhile enabled it to pursue and elude the bomber. There would be a temptation here to conclude that the fighter is on the decline if there were not the hope that the problems of transonic and supersonic flight will soon be clarified. In that event the fighter, for the same reason as beforehand, would regain its speed advantage and therefore its superiority. And this reason strikes us as residing mainly in the fact that the fighter aeroplane, being a weapon symbolic of defence, always has been, and always will be, regarded by governments as the most important item of armament in time of peace.

But even admitting that one day the fighter will recapture its advantage of superior speed, there still remains the fact that two factors will have changed : firstly, the bomber will be capable of still greater speeds than today, and secondly, the fighter's manoeuvrability will deteriorate as higher speeds and, especially, greater altitudes are reached.

Under these conditions, and in view of the disastrous potentialities of such new weapons as atomic bombs, bacteriological bombs, and the like, bombers must be effectively attacked before they have a chance of releasing their warload over a target area ; and the establishment of visual contact can therefore no longer be regarded as the final goal of the interception manoeuvre. Moreover, the fighter must be guided into a position from which it can attack the bomber to advantage ; otherwise it risks losing sight of the enemy during positioning manoeuvres or else wasting a great amount of time before being able to deliver its attack. And in both these events, the bomber would stand a good chance of being able to carry out its mission without suffering a single attack.

It is not aimed in this article to suggest a solution to these problems. From considerations based on aircraft available at present and in the immediate future, an attempt will be made to show that the classical manoeuvre must now be completed by a manoeuvre of close interception, and to reveal the difficulties such a manoeuvre presents in view of the fighter's loss of manoeuvrability at increasingly high speeds.

In this investigation the following performance data will be assumed : *Bomber :* 500 m.p.h. (720 ft./sec.) in ground vicinity ; 435 m.p.h. (640 ft./sec.) at over 36,000 ft. ; ceiling of 46,000 ft. *Fighter :* 600 m.p.h. (870 ft./sec.) in ground vicinity ; 515 m.p.h. (755 ft./sec.) at over 36,000 ft. ; ceiling of over 46,000 ft.

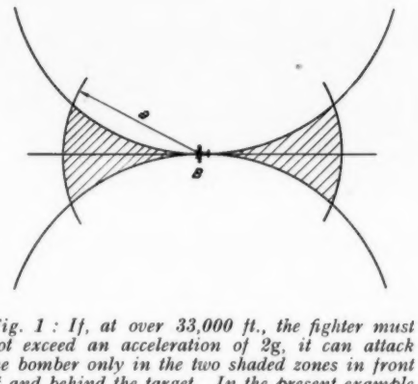


Fig. 1 : If, at over 33,000 ft., the fighter must not exceed an acceleration of 2g, it can attack the bomber only in the two shaded zones in front of and behind the target. In the present example the two circles for y = 2g feature a diameter of 7,350 ft. The maximum firing range, a = *2,600 ft.*

Prerequisites of aerial combat

Modern fighters are armed with automatic guns : heavy machine guns (0.50 inches calibre), cannon of 20 and 30 millimetres, usually in conjunction with gyro sights. Dispersion and accuracy of aim require that fire should be opened at a distance of not more than 2,600 ft., thus placing certain limits on the tactical aspects of the manoeuvre

For adjusting the aim with gyro sights the fighter pilot must sight the bomber through a constant angle for two or three seconds. Hence he fires while in a turn, and the occurring accelerations may not exceed certain values, for physiological and aerodynamic reasons. At low and medium altitudes the physiological effects claim priority consideration and limit the accelerations to four or five times the gravitational acceleration ; above 30,000 ft. the aircraft's structural load factor limits the acceleration to $2g$, after which the maximum permissible acceleration decreases progressively to a value of zero at the aircraft's ceiling altitude. It is not difficult to deduce the resultant tactical consequences for aerial combats at extreme altitudes.

A simple calculation shows that this restriction of the permissible acceleration considerably reduces the fighter's zone of action during the crucial phase of the combat. In theory there are two zones of fire at the fighter's disposal, one from the rear and the other from the front of the enemy. Bearing in mind that the firing range is limited to

2,600 ft., one obtains (Fig. 1) the two zones from which the bomber can be attacked, the maximum angle of presentation being of 20 degrees.

When attacking from the rear the fighter will use its superior speed to take up a position in the shaded zone (of Fig. 1). If the pilot begins to aim from a distance of 3,300 ft., then he has 4 to 5 seconds for adjusting his sights in order to open his fire from 2,600 ft. During the approach the acceleration drops, and the pilot has 7 to 10 seconds in which to fire. If the attack is carried out from the front, totally different conditions arise (Fig. 2). Whilst the angle of presentation tends to augment during the sighting operation, the acceleration increases rapidly as the two aircraft approach each other. The acceleration being limited to $2g$, the angle of presentation is very small during the initial phase of the attack—of less than 7 degrees. Another factor which renders the operation more difficult is the speed of approach of the two aircraft. At a relative speed of about 1,300 ft./sec., the fighter cannot take up, within a few seconds, a position in the attack zone unless it has been directed in this manner during the ten or twenty miles preceding the visual contact. But even if this has been done, the pilot has scarcely more than one second in which to open fire, so that the possibility of destroying the target is extremely remote. (According to statistics of World War II, it required 50 to 60 hits with a machine gun, 20 hits with 20-mm. shells, or seven hits with 30-mm. shells to bring down a B-17 "Flying Fortress.")

During the last war fighters attacked bombers only exceptionally from the front. Nevertheless, the Germans practised this tactic—Allied fighter escorts and the bombers' defensive armament gave them no alternative—and claimed that it was successful. But it must not be forgotten that, in those days, speeds of 400 m.p.h. and combat altitudes of 26,000 ft. were rarely exceeded. Our first conclusion, therefore, is that solely attacks from the rear can promise success.

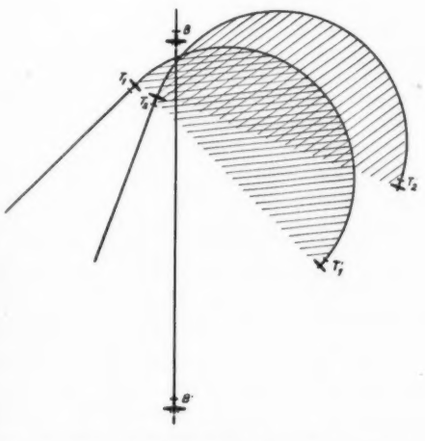


Fig. 3 : Even if the fighter sights the target two miles before the attack, and immediately begins to turn, it will lose a considerable amount of time because, at the end of the turn, it will be 4 miles (45 deg. angle of presentation) or even 7 miles (20 deg. angle) behind the bomber.

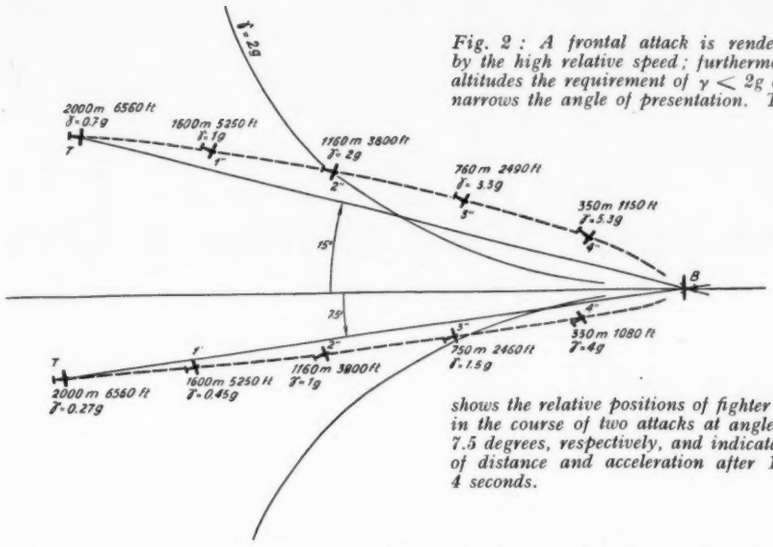


Fig. 2 : A frontal attack is rendered difficult by the high relative speed; furthermore, at great altitudes the requirement of $\gamma < 2g$ considerably narrows the angle of presentation. The diagram shows the relative positions of fighter and bomber in the course of two attacks at angles of 15 and 7.5 degrees, respectively, and indicates the values of distance and acceleration after 1, 2, 3 and 4 seconds.

Consequences of manoeuvrability losses

An aircraft's manoeuvrability in combat is characterised by the ease with which it can turn. The radius of the turn depends upon the flying speed—itself variable between the stalling speed and the maximum speed (critical Mach limit). At low and medium altitudes the maximum load factor increases with the speed, and the turning radius remains small even at very high speeds. At extreme altitudes the speed range narrows more and more, and the load factor drops as the ceiling altitude is approached. Thus we can define a very small speed zone for which there exists an optimum load factor and therefore the smallest possible turning radius.

Whilst these conditions depend essentially upon the qualities of each aircraft, we shall base our considerations on a hypothetical fighter which, at 46,000 ft. altitude, possesses an optimum turning speed of 500 m.p.h., yielding a minimum turning radius of 2.8 miles.

If this fighter is guided into position at 45 degrees in front of a bomber (Fig. 3), recognises it from a distance of a mile and immediately begins to turn, it will be situated at 4 miles from the bomber after having completed a semi-circle—and the bomber will since have travelled from B to B'. In the best of circumstances the fighter can start attacking after 4 minutes—in which time the bomber will have travelled about 30 miles. The conditions relative to a frontal attack are still less favourable : after a 100-deg. turn the fighter is 7 miles away and needs to fly straight ahead for 45 miles before catching up with the bomber. Meanwhile, it must be realised that this calculation is an optimistic one, since it is based on optimum values which may never be attained in practice. Nevertheless, these figures show, by virtue of their order of size, the enormous influence of increasing speed and operational ceiling, and loss of manoeuvrability.

Thus, in the presence of modern, high-altitude, high-speed bombers, the ground command can no longer be content with merely establishing visual contact between the fighters and the enemy bombers, and then leaving the rest to the fighters. Unless the contact is established in a given zone to the enemy's rear, the fighter will have to execute such large, time-consuming manoeuvres that the pilot will very probably lose sight of the bomber and in any case lose a lot of valuable time. If the fighter is to intercept rapidly and under conditions which promise success, then the ground command must guide it to within firing range—be this by means of complete radio guidance from the ground, be it by means of new airborne detecting equipment.

The exploits of a few Convair B-36 very heavy bombers, which succeeded in covering several thousand miles in transcontinental flight at great altitude without encountering serious opposition from fighters put into action against it, were acclaimed by the U.S. press and fortified the position of the protagonists of the very heavy strategic aircraft. But the failure of the interception must be ascribed to the imperfect detecting equipment and to the long periods of time required for reaching bombers flying at great altitudes. On the other hand, the existence of the problems mentioned here was placed in evidence by the fact that the few interceptions that were successfully organised, incurred but one single attack. And this notwithstanding that the B-36 has not altogether the flight performance figures on which this study is based. We may therefore assume that the problems presented here have not yet been solved and that their topical importance places them at the focal point of technical and tactical research.

Hermann Oberth, Shaper of Things to Come

A new power is born

A whining swish is briefly audible above the big city's lethargic midday hum. Then a deafening explosion rends the atmosphere. A moment later smoke and dust loom above flaming ruins. Like the hill-top signalling fires man had used centuries beforehand, a gigantic mushroom in the sky broadcasts the alarm to an air force base. Radar traces the missile's origin while sleek, murderous monsters ascend at dizzy speed, their exhausts spitting fire. In a few hours they are over the enemy target thousands of miles away, encountering anti-aircraft missiles—slender, winged contrivances which, though unmanned, knowingly seek out the avengers, relentlessly pursuing them through mad convolutions. The sky, fouled with flares and bits of metal, resounds to screaming supersonic air-to-ground projectiles and ultimately trembles to the dual thunder of mass destruction below and above.

Laying down the telephone, a man rises contentedly from his chair and steps outside the hut to where a brightly painted truck is stationed. He takes his place at the wheel, lights his pipe, and gazes skywards through half-closed eyes. A grey shape is discernible in the sky—a tubular device with huge fins, slowly falling on the end of a large parachute. It lands a little roughly on the huge, pock-marked meadow. The truck speeds towards it, and the man pushes back his postman's cap as he prepares to unload from it sacks of mail—letters and parcels which, only a few hours beforehand, had been on the other hemisphere. A parcel marked " Urgent ! " is addressed to a biological research laboratory. Soon its contents are being examined under the microscope. A scientist diagnoses a particularly contagious disease, and orders are rapidly transmitted to the Post Office to prepare for a priority despatch. A few hours later another missile drops to earth, thousands of miles away, bearing life-saving ampoules of serum. A disastrous epidemic has been avoided.

All too fantastic ? Yes, in so far as we shall not see both pictures come true. But we shall see one of them—perhaps very soon. Which one, depends on how man chooses to make use of his newest motive power—*rocket power !*

His newest power ; and yet one of his oldest. Legend says that rockets were first fired around 3,000 B.C. by the Chinese, or at least so long ago as to place them many centuries before the steam engine. Why, then, are rocket motors the product of such recent research ? Perhaps chiefly because our forefathers didn't know what to " drive " with rocket power. It wouldn't turn a wheel, for example. Any other goal, such as high travelling speed, didn't occur to them. Strangely, the goal that was ultimately to drive them on is still in a distant future—interplanetery travel !

Capable of moving at high speed in prescribed directions through the vacuum of cosmic space. The simplest motor imaginable. Just a combustion chamber with a nozzle-type exit ; no piston, crankshaft, compressor or turbine wheel ; no moving part at all. In use for about five thousand years, and its scientific principle explained two-and-a-half centuries ago by Newton. Yet it was not until the beginning of our century that the implications of the rocket as a means to space travel were understood.

Science steps in

In 1903 a Russian schoolmaster and self-taught physicist, Ziolkowsky, proposed a rocket with a liquid instead of a solid propellant, and advocated it for space travel. (Liquid propellants marked a big step forward in the understanding of rocket possibilities.) In the U.S.A. Professor Goddard, who had experimented with powder rockets since 1915, began practical tests with liquid propellants in 1920 and six years later claimed the honour of having fired the first liquid-propellant rocket. But in Europe there was a man who, in his pursuit of spaceships, delved so deeply into the subject that, by 1920 or thereabouts, he had unwittingly furnished all the scientific principles and practically all the technical details of what was to startle the world *twenty years later as the long-range V-2 missile !*

Born on June 25th, 1894, in Hermannstadt, Transylvania (then a Hungarian crown-owned country, which later became Rumanian), Hermann Oberth was of a studious disposition and spent his youth in scholarly surroundings, for his father was a doctor. As a schoolboy he read, like many boys of his age, Jules Verne's *De la Terre à la Lune*, in which it was proposed that a " moon-gun " should fire a manned projectile to our satellite. His imagination was stirred by Verne's scientific approach : the suggested muzzle velocity of the gun, 36,000 feet per second, was indeed the so-called " escape velocity, " the velocity a missile must attain in order to escape from the earth's gravitational field. But Oberth realised that Verne had sadly underestimated the resistance of the air—and considerably overestimated that of the passengers !—and that clearly this was no way to achieve space travel.

Oberth was determined to find a feasible method. Accordingly, after leaving school he approached the problem in a scholarly fashion by studying mathematics, physics, and natural science. After a year at Munich University, the war broke out. Invalided on the Russian front in 1915, he was sent back for recuperation to Schässburg, Transylvania, where he was attached to the army medical service at the hospital and remained until war's end. This gave him a chance to pursue his studies, now on astronomy and rocket theory. In 1918 he continued studying mathematics at the Universities of Klausenburg (Transylvania), Munich, Göttingen and Heidelberg, until 1923 when he was given the title of professor by the University of Klausenburg. That year marked the first public airing of his rocket and space travel theories, when the firm of R. Oldenbourg in Munich published his *Die Rakete zu den Planeträumen* (The Rocket into Planetary Space).

An ultra-scientific book, it was not exactly a " best-seller " ; in fact, Oberth paid part of the publishing cost out of his own pocket. In it he treated rocket problems from what was then a revolutionary but now a classical angle. He calculated with " mass-ratios " (the proportion between the weight of the fuelled and of the empty rocket), " exhaust velocities," and how these could best be stepped up with liquid propellants (an opinion he had expressed as early as 1914, actually suggesting the alcohol and liquid oxygen mixture used in the V-2) ; the influence of exhaust velocity and mass-ratio on " rocket velocities." Among strikingly new ideas on rocket construction he proposed the first self-cooled rocket motor, with the propellants circulating through a cooling jacket before entering the combustion chamber ; he thought up a thermostatic control of the cooling jacket flow, and pumps for injecting the propellants under pressure. Because high mass-ratios would incur unsurmountable constructional difficulties, he pro-

posed the step rocket. (This principle was used recently in the U.S.A. when a two-step rocket, consisting of a V-2 and "WAC Corporal," was fired to 250 miles altitude over White Sands.) Every aspect was dissected mathematically.

The ensuing period was nevertheless not a happy one for Oberth. Scientists were sceptical and tried—though in vain—to demolish his theories. While his primary interest was space travel, his book provided more than sufficient data on which to start war rockets. But he had approached the military in 1917 already, only to be turned down; and his first sponsor was now a civilian, a banker in Würzburg. With the promise of financial support Oberth began experimenting at his own expense. But the banker thought twice and submitted Oberth's project to a Professor Francke of the Berlin Technological Institute. Francke's reply was brief: Oberth's calculations were right but his "basic principles" were wrong. The banker never produced the funds and Oberth, having spent all his money on tests, was financially ruined. Still today Oberth does not know what was wrong with his "basic principles," although the V-2 has since more than proved its ability to ascend!

Embittered, Oberth returned to Transylvania. There were no "Wanted—Space Traveller" signs to be found, so he took a job as a mathematics teacher at the secondary school in Mediasch. But his work caused a rocket craze to break out in Germany; during 1927 and 1928 the press carried vivid headlines on rocket-propelled automobiles, sledges, gliders, and all sorts of vehicles, though nearly all using powder rockets. In 1927 a group of serious enthusiasts formed the *Verein für Raumschiffahrt* (Society for Spaceship Travel) in Breslau, and started publishing various sound articles on the subject. And then, in 1929, there appeared another book by Oberth—*Wege zur Raumschiffahrt* (Roads to Spaceship Travel), a formidable volume which, in many respects, is still the most valuable theoretical work on the subject.

Meanwhile, this public attention received by rocketry and space travel also aroused the imagination of a man whose colourful career was based on sensation—Fritz Lang, producer for the UFA Film Co. Deciding that the time was ripe for a film on lunar travel, he had his wife, Thea von Harbou, write a script for *Die Frau im Mond* (Girl in the Moon) and requested the services of Oberth as "technical adviser." Oberth obtained leave of absence from his teaching and went to Berlin. He accepted to build, within three to four months, a liquid-propellant rocket which, for publicity purposes, would ascend on the day of the film's first showing. He couldn't have made an unhappier decision, for matters took a catastrophic course.

Oberth of course saw in it a chance to try his hand again at building rockets. But, lacking in mechanical knowledge, he had to hire assistants, and his choice in this respect was unfortunate. Moreover, the time was too short. Nothing satisfactory materialised, one explosion nearly blinded Oberth, and the UFA didn't obtain its rocket. On the verge of a nervous breakdown, Oberth fled Berlin for a while.

But he learned a lesson: "Never invent what you cannot build with your own hands." The scholarly professor consequently set aside his theories from 1930 to 1933, and earnestly applied himself to learning workshop practice and machine drawing.

Others learned a lesson, too; a lesson which was later to culminate in a hail of 2,000 V-2s on England and 1,600 of those deadly weapons on Antwerp. For the parts of his film rocket were salvaged by the Society for Spaceship Travel, which had since opened a branch in Berlin, acquired a testing ground outside the city, and started experiments under Oberth, who returned to Berlin for a few months before retiring to Mediasch. Except for a few who left Germany, almost all the Society's Board members later figured as leaders of the Reichwehr's awesome Peenemünde project.

Oberth's subsequent activities were largely cloaked in silence. And, as usual, this gave rise to many rumours. Because the German rocket weapons bore such a striking resemblance to Oberth's early projects for space rockets, it was thought that he must have played a major rôle at Peenemünde. Indeed, the records since found on the Peenemünde developments show that every time a departure was made from Oberth's suggestions of two decades earlier, failure resulted. Yet nowhere was his name seen in connection with any of that infamous centre's products.

The not-so-mysterious Professor

The answer to this mystery struck me almost immediately upon meeting Professor Oberth. His modesty and old-world courtesy must not have rated high among the Prussian pomp and clicking heels of the Reichwehr officer engineers running Peenemünde. I found him in a modest boarding-house in Berne—tall, thin, tired-looking yet erect, with a thick crop of grey hair, a square-cut jaw, a grey moustache, and eyes which go with only an alert mind. He told his story in a soft voice with auditorium precision.

"After resuming some small-scale experiments in Mediasch, I was given a professorship at the Vienna Technological Institute in 1938. I did some research work there, and made a few inventions. When war broke out I was bound to secrecy.

"In 1940 I was transferred to a similar post in Dresden, and headed a department assigned the construction of propellant pumps for the future V-2. After a while I wanted to return home to Mediasch, but was told I already 'knew too much' for a Rumanian.

"An order came in 1941 for me to go to Peenemünde. What I found there did not impress me very favourably. As you know, the place was run mostly by former assistants of mine in Berlin. Among them was notably Wernher von Braun, who later headed the V-2 project. I felt I could have avoided many of the mistakes made there. But, like other scientists, I was called in very late, and even then was kept down. My first task was to search through all available patent applications for anything useful to rocket technique. Additionally I calculated optimum ratios for step rockets, submitting my formulae and results in a secret report."

At this point he stopped and looked at me questioningly.

"But didn't you develop any of the Peenemünde projects yourself?" I asked.

"Nothing that saw service," he replied. "I worked out some plans for a long-range rocket. This has since been mentioned in a few international publications. I also wrote a report on anti-aircraft rockets—large guided-missile types. My last work at Peenemünde was concerned with the wind tunnel."

"Was that your last war assignment?"

"No. My anti-aircraft report was taken notice of, and in 1943 I was called by WASAG to develop my project.

"WASAG?" I queried.

"The Westphälisch-Anhaltische Sprengstoff A. G.," he explained. "The plant was at Reinsdorf, near Wittenberg. My results were very satisfactory. But the war ended before the rocket could be put into operation."

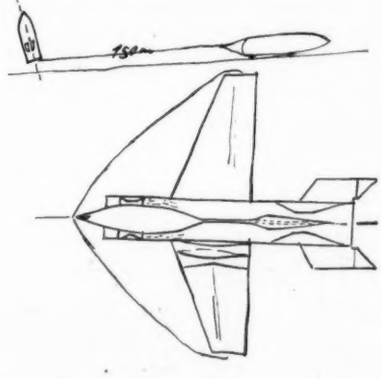
Then he raised his eyebrows and chuckled: "After that I was thrown into the dustbin!"

He quickly came to my rescue: "'Dustbin' was the name of the American camp. But it was a misnomer, for I honestly cannot say I have any bad souvenirs of the four months I spent there. Afterwards I was allowed to return to my house which I've had since 1943 at Feucht, a village outside Nurnberg."

"How come you didn't go to the U.S.A. like others of the V-2 team?" I asked.

"I think von Braun stopped that," he replied curtly.

Prof. Oberth explains that his projected ramjet aircraft, with ramjet units inside the wing and extending over the entire span, would be launched by means of a large rocket, attached with a cable of about 150 metres, fired almost vertically. A screen extending from the wing tips over the fuselage nose would cover the ramjet inlets and be released once altitude had been gained.



" Did the Russians ever approach you ? "

" Not since the war. A Soviet emissary asked me to join them in 1933. I refused, and he said they'd carry on anyhow, whether I came or not."

" What is your main occupation at present, Professor ? "

" My main occupation ? I'm writing a philosophical book ; something I really started in 1917. As a matter of fact I was working on it just as you came." He pointed to a stack of typewritten pages alongside a portable typewriter. " I also work together with a few other scientists and engineers who have no job. We run a technical consulting agency, accepting all assignments and turning each over to the most competent colleague. Otherwise I work in my garden. I've a family, you know ; wife and two children," he added, quietly. " I lost two in the war."

I waited a few seconds and then popped the question : " Have you any new theories on space travel ? Anything up your sleeve ? "

" Yes. I have a few new theories, as yet unpublished. But most of my ideas are to be found in my books. As for something ' up my sleeve, ' well, as a matter of fact I have some inventions I haven't disclosed yet. Also, I've worked out complete plans of a ramjet aircraft capable of some 2,600 m.p.h. at about 20 miles altitude. It's simpler and cheaper to build than most aircraft, and over a given distance it would consume only 10 per cent. of the fuel required by a conventional aircraft of the same load capacity."

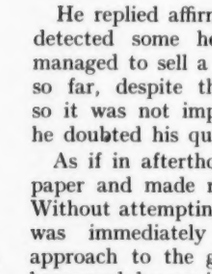
" For sale ? " I enquired.

He replied affirmatively. But I fancied I detected some hesitancy. He has never managed to sell a single one of his projects so far, despite their proven effectiveness, so it was not improbable, I thought, that he doubted his qualities as a salesman.

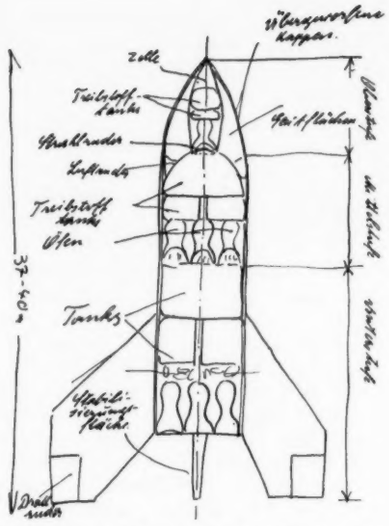
As if in afterthought he took a piece of paper and made me a rough sketch of it. Without attempting to criticise it, one thing was immediately apparent : the direct approach to the goal of the problem, unhampered by engineering convention ; perhaps the key to all Oberth's success in solving entirely new and difficult problems.

" As regards space travel, Professor, what do you think of the Earth Satellite Vehicle Programme announced by the Americans ? "

" Well, I don't know any details of that programme, as it is being held secret. But I would say that we definitely do possess the technological means today to place a space-station on an orbit around the earth."



Prof. Oberth proposes that rockets returning to earth should descend tail-first by parachute.



Explanatory sketch, by Prof. Oberth, of a three-stage rocket for travelling from the earth to a space-station.

" How would you advocate setting about this, operationally ? "

" First I would send a good-sized high-performance rocket along a synergy curve —that is, a curve compromising between the most efficient ascent, horizontally due East to benefit by the earth's rotation, and avoidance of excessive air resistance—and have it orbit at some 900 kilometres altitude. This would form a nucleus around which to build the station."

" What would the characteristics be of such a rocket, counting on presently available exhaust velocities of around 3,000 metres per second ? "

The professor took a sheet of paper and a pencil, made a small sketch of the trajectory, a brief calculation on the slide-rule, and announced an ideal rocket velocity of 8,400 to 8,800 metres per second, requiring a mass-ratio of about 16, which, he said, would be impossible constructionally. Another brief calculation, and he advocated three steps, each of 2.5, which, he declared, would be possible.

I asked what form he imagined a space-station should have. By way of reply he drew a circle, indicating it as the central station where weightlessness would reign, and two more circles, the observation quarters, one on either side of the central part, diametrically opposed and connected by long tubes which, he explained, would be about six kilometres long and connected with the centre by lifts. The entire assembly could then rotate at a reasonable speed which would not make the inhabitants of the outer quarters dizzy and yet produce enough centrifugal force to give them their weight back again. Assembling it would be long and tedious, requiring numerous ascents with similar rockets, though manned. Parachutes would be used for landing back on earth, with the rocket descending tail first.

" There's talk of sending a rocket to the moon and having it release a magnesium flash upon arrival. Would that be feasible ? "

" Certainly ! Professor Goddard suggested that years ago. Very clever man, Goddard. We corresponded a great deal. But he made a mistake in calculating the luminosity of his magnesium flash, though his rocket proposals were perfectly sound. Anyhow, if I were to plan the experiment now, I would advocate a radar principle for continuously telemetering the rocket's distance away from the earth, and the precise instant of its arrival on the moon. The flare would give you only the moment of arrival."

" Would it have to be a very big rocket ? "

" Let's see. Say 100 kilograms for the telemetering equipment, 3,000 metres per second exhaust velocity again. You'd need... about 12,000 metres per second ideal rocket velocity, counting air resistance." He jotted a few figures and whipped out his slide-rule. " That would make a mass-ratio of 54. Too high for three steps. Let's try with four." Another brief calculation and he announced it : " Yes, four steps, each with a mass-ratio of 2.72. Going to be a pretty big rocket." Five minutes later he had worked out the weight : " 56,200 kilograms. 56 tons ! But it would probably be less in reality. You see, we can get exhaust velocities up to 4,000 metres a second, and don't forget that figure increases to over 5,000 when the air gets thinner in the upper levels."

" Won't atomic energy change the picture considerably in that respect ? "

" Yes and no. Atomic energy will certainly bring forth far higher exhaust velocities, but it will be prohibitively expensive until we find a fissionable substance other than uranium."

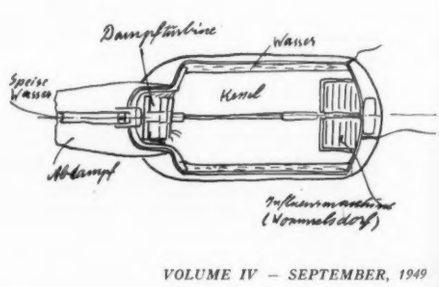
" But won't nuclear motors be necessary, anyhow, before we can build a spaceship and really travel around the moon and planets."

" Not at all. I wouldn't advise travelling direct from the earth to the planets. My idea is to start off from the space-station in the electric space-ship."

" Excuse me, but... what, precisely, is an electric space-ship ? "

" Briefly, my idea is to collect solar radiation with mirrors, obtaining heat and transforming it, through a system of turbines and Wimshurst machines, into electricity. This would maintain a large potential difference between two very big electrodes ; a flow of ionised particles would arise—this flow being

Prof. Oberth's sketch of a generating system, with steam turbine and Wimshurst machine, for converting solar radiation into electricity for driving his electric space-ship.



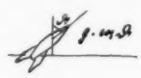
Professor Oberth's own drawing of his electric space-ship project for travelling from a space-station to the planets.

the jet. Several of the generators would be electrically coupled to drive a vehicle much like the space-station, with the observation quarters at the end of long arms and the electrodes in the centre. Electrodes could also be attached to the generating elements themselves. Here, I'll make you a sketch of it. Incidentally, the solar radiation could also be used to generate electricity through large thermocouples. The ship would travel from very slow to 12 or 15 kilometres per second, and trips could be made as far as Saturn."

" Then, in your opinion we have today the means to visit most of the solar system ? "

" Of course ! In fact, we had all that three decades ago. I proved it conclusively in my books. It's just a matter of going right ahead."

He spoke gently but unhesitatingly. His amazing statement seemed to ring with infallible truth.



Man's technological progress through the ages indicates that he will definitely visit the Universe one day. Then—and unfortunately only then—may full justice be rendered to Hermann Oberth.

Research at Work

Those times when science prepared the way for technology and industry, but without being their servant, seem now to belong irrevocably to the past. The tempo of modern industry together with the requirements of total warfare have not only eliminated the advance pure science possessed over the industrial evaluation of its postulates and discoveries, but have even largely reversed the conditions. Pre-planned and organised research has therefore had largely to replace free science.

A glance at some of the discoveries of special importance to aeronautics may substantiate this assertion : nearly two centuries passed between the discovery of the basic laws of hydrodynamics in 1738 by Daniel Bernoulli and their practical application to the aircraft wing ; several decades elapsed between the time when Carnot (1824) and Clausius (1850) recorded their observations and the first Otto-cycle and Diesel engines came into being. But the radio industry was much quicker to evaluate the Hertzian radiation (1885), and only a few years transpired between the theoretical solution of the nuclear fission problem (1939) and the devastation of two big cities...

The result is that the contemporary disciples of Galileo and Newton have turned themselves from sorcerers into sorcerers' apprentices. No longer can they rid themselves of the spirits they invoke. Unlimited expansionism of thought and will had not remained the monopoly of scientists. The majority of politicians, militarists and many captains of industry have learned how to represent this kind of boundlessness incomparably more thoroughly. Should they desire tomorrow to make of the moon a military base, the since enslaved scientists would have to solve the relevant problems to a fixed schedule, and the engineers would have to build the necessary machines accordingly. That's what they are paid for ! Thus, they are now working—except for vanishing exceptions—a prescribed eight hours a day on solving problems of splitting atom nuclei or of celestial navigation of unmanned rockets.

New scientific discoveries are now measured against investments of dollars, pounds sterling, or rubles, and are dependent on the ruling political goals. The goals themselves, however, very frequently do not seem to have been set with " the greatest happiness for the greatest number " in mind. Perhaps more for " the greatest power for the smallest number."

Let us confine our considerations to aeronautics, which has doubtlessly imposed the most visible changes on the structure of civilisation—and which can claim probably the greatest importance with regard to the direction civilisation will take. In this connection the cleft running through our globe becomes again, and very clearly, apparent. The East regards the aeroplane, like many other items, as nothing but a weapon ; the occasional use of courier aircraft for official persons does not contradict this statement. For the West, however, the aeroplane, in addition to being an instrument of transport, too, is also a constituent of that personal freedom which characterises Western civilisation. The political, economic, and spiritual shape taken on by the society of free nations is unthinkable without civil aviation. But as long as the East forbids principles making possible free civil air transport the world over, the West will not be able to abandon its struggle for superior military aircraft.

For this reason aeronautical research in the West is confronted by a dual and therefore greater task : the provision of *superior military aircraft* and *more economical civil aviation*. In all domains of aviation technology and industry—and consequently of research, too—there is evidence of this dual activity, with a time-dictated priority given to aerial armament. To fly faster, higher, further, with heavier weapons and in every weather, is still the most important goal ; safer, more comfortable and more economical civil aviation takes second place. The present level of progress is not characterised by large serial manufacture as much as by the technological marvels of prototype and experimental aircraft, advanced research, projects for tomorrow and the day after.

New land is being trodden everywhere. Most of the results of independent research in the individual sciences have already been drawn into the overall progress, this with the help of gigantic organisations and indexing agencies. The solution of concrete problems by state research laboratories, universities and the industry itself, is yielding new facts. In the United States of America, for example, there are three large state laboratories which work with several gigantic subsonic wind tunnels for full-scale specimens, numerous smaller supersonic wind tunnels and other testing equipment, in their endeavours to solve such problems. Additionally, seventy-three universities and institutes have received many hundreds of contracts to carry out basic research work. Among the U.S. aeronautical manufacturing firms working to government order, Boeing is tackling problems of high-altitude flight, Bell, Douglas and Lockheed are working on questions of high-speed flight, Fairchild and ten other firms are engaged in the project for applying nuclear energy to aircraft propulsion.

The aspects of modern research, by virtue of their manifoldness alone, are difficult for the outside observer to assess. Only parts

Fig. 1 : This roomful of complicated switchboard-like machinery comprises the ENIAC, an electronic calculating machine developed by Pennsylvania University's Moore School of Engineering in Philadelphia. The basic functions executed by this machine are addition, subtraction, multiplication, division, and the storing of numbers. From these, more complex problems, such as differentiation and integration, may be solved. The machine was developed with the cooperation of the U.S. War Department.

Fig. 2 : The Curtiss-Wright Dehmel Electronic Flight Simulator enables arbitrary combinations of operating conditions to be simulated—e.g., for the design of control equipment. This photo shows it built into a duplicate of the cockpit of a Boeing " Stratocruiser " as a means of training flight crews, whose performance is traced by a " scriber " and checked by the instructor (right). Direct consequences of the crew's control movements (dynamic pressure changes, banking angles, r.p.m. variations, etc.) are simulated on the cockpit instruments and can be felt as control forces.

of the relevant reports are released to the public ; comprehensive presentations are scanty. Nevertheless we shall try to assemble a picture of the present problems and developmental trends of aeronautical research, using the latest publications of the U.S. National Advisory Committee for Aeronautics (NACA), the most recent " Reports and Memoranda " of the British Aeronautical Research Council (A.R.C.), the " Bulletins " issued by the French ONERA (Office National d'Etudes et de Recherches Aéronautiques), and last but not least the reports on the First International Congress of Aeronautical Manufacturers.*

Methodology in research

Whilst the procedures of observation and measuring technique—apart from their far-reaching refinement and adjustment to the processes under examination—have undergone but slight fundamental changes, the significance of mathematics for evaluating and applying the observations has increased in recent years. Alongside the effects of a wider utilisation of series analysis (Fourier analysis—*e.g.*, for flow processes) and the Laplace Transform (for servomechanisms), this is primarily due to the recent introduction into practical research of large-scale, high-speed electronic computing machines (the ENIAC, etc.), as developed by a number of U.S. universities (Harvard, Pennsylvania, etc.) with government aid (Fig. 1).

With such automatic calculators it is possible, from empirically-ascertained measurement data on test series (*e.g.*, on flow in compressible boundary layers), very quickly to derive generally-valid mathematical equations for analogous processes. Then, once the equations for a group of processes are known, it is an easy matter for these machines to play around with them and pick out optimum solutions, even if numerous variables have to be accounted for. Calculations which the slickest mathematician might need years to work out, are settled in a matter of hours or days by such " adjustable mechanical brains." For example, extremely complex oscillation investigations for an entire group of variables can be executed (in accordance with the familiar laws) without loss of time.

Finally, in the case of mixed processes whose fundamentals are only partly known and partly uncertain, similar electronic devices, known as Simulators, enable every conceivable combination of variables to be assumed, fed into the system, and investigated. A practical example of this is the Curtiss-Wright Dehmel Electronic Flight Simulator (Fig. 2), with whose aid the control and servicing system of the Boeing " Stratocruiser " was developed to provide the best conditions. All types of combination (of longitudinal and lateral attitude, position of wing flaps, cowl flaps, landing gear, C.G., etc. ; of trimming, gross weight, dynamic pressure, temperature and altitude ; wind-milling or feathering of any or all propellers) can simply be switched into the apparatus and transformed into control forces, stick travel, etc., by the electronic devices, power amplifiers, etc. Once the development work on the aircraft has terminated, the simulator can be built into a full-scale cockpit mock-up and used as a money-saving but nonetheless true-to-life means of training flight crews.

Supersonic aerodynamics

Since manned aircraft have pierced the sonic barrier in horizontal flight—as, for example, the Bell X-1 in October of 1947, the Douglas D-558-2 " Skyrocket " in March of this year, and probably also the German-Russian DFS-346—the leading rôle of this research branch can no longer be ignored. It is true that the Swiss aerodynamicist, Professor Ackeret, investigated as early as 1925 " air forces on wings moving at speeds greater than that of sound " (*Zeitschrift für Flugtechnik und Motorluftschiffahrt*, Vol. 16) and was followed in the early ' thirties by German, British and Italian aerodynamicists (Busemann, Prandtl, Schlichting, Lighthill, Ferri, etc.). But this field was, until about ten years ago, chiefly of interest to ballisticians. Meanwhile the situation has changed: supersonic research has become " the thing."

In this branch the main goal is doubtlessly to re-establish the performance-wise superiority of fighter aircraft over high-speed bombers operating near the sonic limit and, in a way, acting under the protection of this natural barrier ; if this goal is not attained, the bombers may become the almost supreme rulers of the airspace. Also, supersonic flow studies are indispensable for designing the shapes of guided A.A. and offensive rocket missiles as well as long-range artillery projectiles (with or without tail fins). Finally, the prerequisites for intercontinental turbojet and rocket airliners, to operate at about 40,000 metres, are already the object of research.

*The following abbreviations will be used for future reference: A.R. 1948 = 34th Annual Report of the NACA, 1948 ; T.N. = Technical Note (NACA) ; R. & M. = Reports and Memoranda (A.R.C.) ; C.I. 1949 = Congrès International des Industries Aéronautiques (Paris, 1949).

A plethora of general and special problems therefore confronts flow research. Favourable sections and plan-forms for wings, control surfaces and fuselages have to be obtained in order to provide highest possible L/D ratios at supersonic speeds. The lift —and its chordwise distribution—is defined by the familiar peculiarity of supersonic flow to transmit disturbances only downstream (which is particularly important in connection with control-surface effects) and is therefore almost entirely dependent on the local angle of attack. The drag (*i.e.*, total drag) has only the—often quite considerable—frictional drag as analogue in subsonic flow ; for the rest it consists exclusively of wave drag, caused by compressibility shocks and expansion waves coming from the corners and edges of the body (fuselage nose, wing edges, angular profile lines, wing tips, etc.). The wave drag occurs in place of the form drag and induced drag common to subsonic flight, and is therefore not only dependent upon the aerofoil section but also upon the wing plan-form (R. & M. 1929, 2001 ; T.N. 1449, 1543, 1672).*

With respect to the problems of configuration it is important that aircraft parts which are hit by shock waves from other parts, are subjected to increased drag. The shock waves form, together with the direction of flow, an angle whose sine corresponds to the ratio of the speed of sound to the speed of the aircraft, thus the reciprocal of the Mach number, whereby the angle of aperture at the nose, which defines the flow around the body, is naturally of cardinal importance (Fig. 3). Shock wave interference is one of the grounds for the present experiments with swept wings of different aspect ratio and angle of sweep, with different wing-tip plan-forms, or with delta wings. NACA tests (A.R. 1948) have shown, meanwhile, that sharp-edged *straight* wings are superior to swept wings of great aspect ratio at over twice sonic speed (when even a swept wing, for structural reasons, could never be pronounced enough to be swept behind the Mach cone). Furthermore, it is not excluded that the biplane may find a sort of revival precisely in the supersonic speed range, because, according to Busemann, the reflection and interference of the shock waves from the leading and trailing edges can bring about a sharp reduction of the wave drag at certain Mach numbers (R. & M. 2002).

Among the other aspects of supersonic research, the total movement of the C.P. for the entire range of Mach numbers, which is decisive with regard to stability, takes first place. Measurements of skin temperatures (due to air friction) decide the choice of structural materials ; after this follow investigations of control-surface efficacy, flutter phenomena, etc. Also of great importance are the questions of internal flow at supersonic speeds—*e.g.*, in ramjets and turbine engines. As is known, a change in cross-section of supersonic flow has exactly the opposite effect to that of subsonic flow ; *i.e.*, enlargements of the cross-section lead to speed increases (coupled with pressure decreases), and vice versa. In the majority of cases it is possible to clarify these manifold problems only by means of extensive tests in supersonic wind tunnels.

Happily, such wind tunnels are relatively easy to build for speeds up to Mach 3 or 5, notably in the shape of numerous small intermittent-flow tunnels which draw the air from the atmosphere, non-continuously and over short periods, into a vacuum chamber and bring it up to supersonic speed with Laval ducts (Fig. 4). The same applies to the measuring technique, where it is possible to work with very small models without the accuracy suffering, holding them in place, together with the necessary leads to the measuring instruments, by a rigid bar at the downstream end. An impressive number of supersonic wind tunnels is already available. The U.S.A. possesses, besides a good dozen state-run installations, another half-dozen private constructions. Great Britain has several ; Canada, Australia, France, Italy, Sweden and Switzerland have had some of their supersonic wind tunnels in operation for a number of years already. In conclusion we mention that NACA has devised a method for achieving flow visualisation in flight, using a shadowgraph technique with the sun as light source ; with this it is possible to render visible wing and cockpit-canopy shock waves (A. R. 1948). As far as the hypersonic speed range (over Mach 5) is concerned, research is only just beginning.

Subsonic aerodynamics

The importance of this branch has not decreased any. On the one hand, even supersonic aircraft have to take off and land in the subsonic range, and must thereby achieve high lift, good L/D ratios and stability in flight ; on the other hand, the upper speed limit in subsonic aircraft is less dependent upon increased engine power as upon an improvement of the critical Mach number, at which the local attainment of sonic speed initiates a very sudden increase in drag as a result of the shock waves. Also, attention is claimed by the behaviour of the boundary layer, *i.e.*, the flow directly along the surface of the body.

In the subsonic range investigations have been made of both 8.7 per cent. faired double-wedge supersonic aerofoil sections

* This concept is opposed, incidentally. Von Karman and Schlichting opine that, also in supersonic flight, induced drag occurs as well as wave drag. Lighthill is of the opposite opinion.

Fig. 3 : Photograph taken with the Schlieren optical system used with the supersonic wind tunnel of North American Aviation, Inc. It shows with exceptional clarity (1) bow and (2) trailing shock waves, (3) boundary layer flow and (4) separation, and (5) turbulent wake trailing the model ; (5) density (temperature) changes in the air flow and (6) reflections of the bow wave by the tunnel wall. The angle between the bow wave and the model's periphery indicates that the air flow is at 2.9 times sonic speed, thus Mach 2.9.

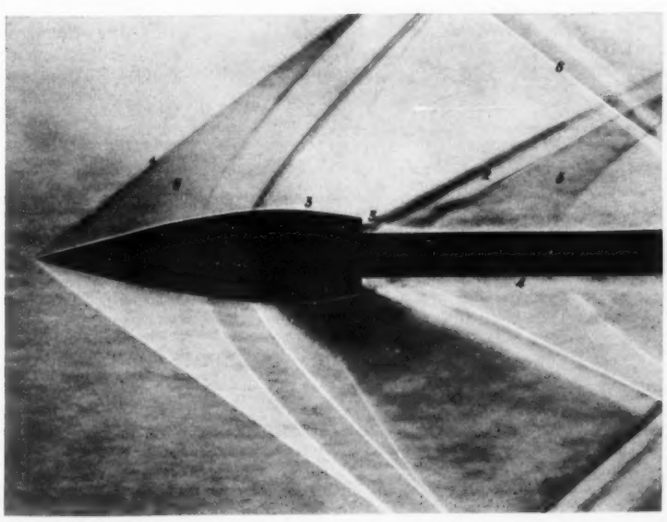
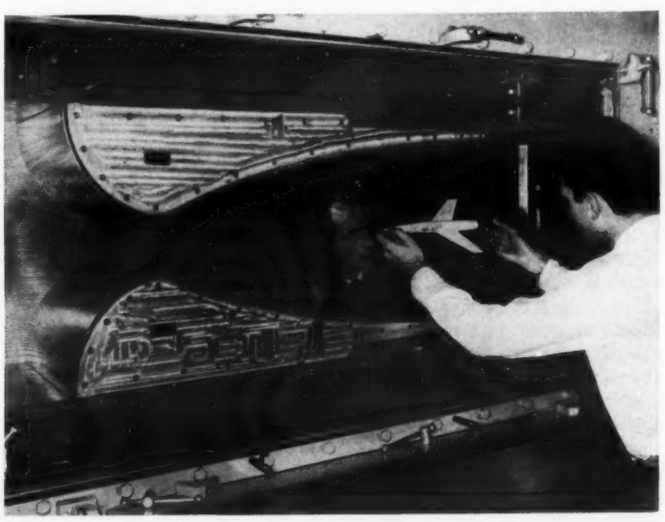


Fig. 4 : In the narrowest cross-section of the Laval duct of a supersonic wind tunnel (here, North American Aviation, Inc.) the air flow is at sonic speed, and below sonic speed upstream of that point. By subsequent decreases of the cross-section the speed of flow—contrary to the subsonic laws—is increased to a multiple of sonic speed. According to the form of the Laval duct, Mach numbers of up to 5.5 may be achieved in the test section. The arresting assembly and measuring leads (at the rear) can no longer influence the flow past the model on that side of the sonic barrier.



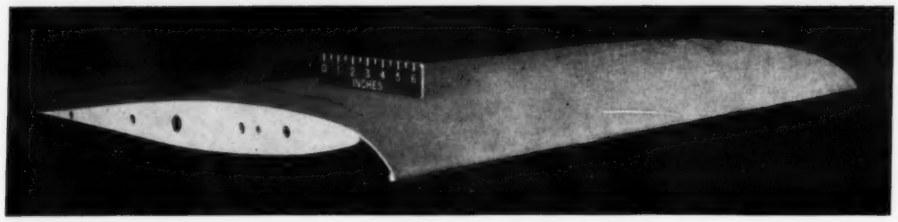


Fig. 5 : Model of a laminar-flow aerofoil section (NACA 64-009) with extended upper-surface leading-edge flap of 10 per cent. wing chord. In conjunction with split flaps lift coefficients of up to 2.6 can be attained in slow flight (otherwise only up to 1.8), whilst the maximum coefficient relative to the wing alone is only 1.1 (NACA photo from T.N. No. 1624).

(R. & M. 2057) and 7.5 per cent. bi-convex supersonic sections (R. & M. 2196). In both cases only feeble maximum lift coefficients (of about 0.7) were revealed, at angles of attack between 8 and 13 degrees, thus giving correspondingly high take-off and landing speeds to be expected. Moreover it was seen that the C.P. in the subsonic range shifts upstream by 20 to 30 per cent. chord and makes effective trimming necessary. Owing to the small maximum lift furnished by supersonic sections at low speeds, new types of high-lift device to aid take-offs and landings became an urgent necessity. In this connection it was found that leading-edge flaps, either sliding forwards along the upper wing surface or hinging at the leading edge and deflecting from the lower surface, furnished better maximum lift coefficients than the conventional trailing-edge flaps, although they give rise to a further forwards shift of the C.P. (Fig. 5). In order to cope with C.P. shift, studies were made of combinations involving leading-edge flaps and split flaps (A. R. 1948). This new type of high-lift device is recommended even for laminar-flow aerofoil sections, which are used only in fast subsonic flight (T. N. 1624). Extensive stability investigations made with scale-model aircraft and experimental aircraft at above and below sonic speed revealed anew the advantage of the delta wing configuration (A. R. 1948).

A whole series of research reports deal with the attainment of critical Mach numbers with subsonic aerofoil sections and compare the qualities of the various sections ((R.M. 2058, 2093, 2159, 2246, 2251, 2264, and others). Other reports treat the influence of fuselage and engine nacelles, or details of the fuselage, on high-speed performance (T.N. 1593, 1662 ; R. & M. 2235 ; and others) or investigate aileron power at high speeds (R. & M. 2185, 2186 ; T.N. 1473).

Best known are the improvements of critical Mach numbers achieved by means of swept wings (ONERA Bulletin Nos. 3 to 5). Here the shock-wave formation due to the local excesses of sonic speed at the thickest parts of the wing, together with its damaging effects on drag and stability, is delayed by the circumstance that each wing-half moves obliquely through the air. The flying speed therefore incurs a chordwise flow across, and a lengthwise flow along, each wing-half ; of these, as Betz has shown, only the chordwise flow can give rise to shock waves. If equipped with sharply swept wings (*e.g.*, of 45 deg.)

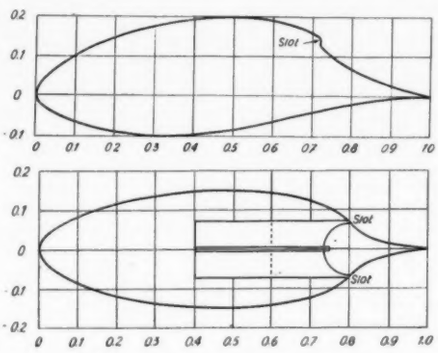


Fig. 6 : Laminar-flow aerofoils with provision for boundary-layer suction can assume the oddest shapes ! The upper diagram is of M. B. Glauert's (N.P.L.) 30 per cent. section, the " GLAS 14, " for boundary-layer suction on one surface at 70 per cent. chord ; the lower diagram is of an equally thick section, designed by Richards, Walker and Taylor of the N.P.L., for boundary-layer suction on both surfaces at 80 per cent. chord. According to the suction volume, both sections give maximum lift coefficients of 2.5 or more.

aircraft may therefore attain sonic speed, and even exceed it, whilst the local speed component, which is responsible for the shock wave formation, remains below the sonic limit. Nevertheless this applies only to the outer sections of the wing ; in the centre section, where the outward flow is just beginning, shock waves still arise—a reason

Fig. 7 : Suction slots at 20 per cent. chord can restore to laminar condition (black portions) boundary-layer flow which has become turbulent because of surface excrescences. In order to show the difference when no suction is applied, the upper portion of the slot was taped over. (N.P.L. installation ; " Flight " photo.)

for making the chord of swept wings smaller at the tips than at the roots (Republic XF-91), thereby simultaneously meeting the dreaded break-away of the flow at the wing tips in slow flight owing to obstruction of the outward flow by the wing-tip vortices (wing-tip stalling). Similarly, studies are being made with reduced aspect ratio, and combinations of reduced aspect ratio and sweep-back, as a means to improve the critical Mach number, which have led to the delta wing (A.R. 1948).

A great amount of interest is earned by the studies on boundary-layer flow. It has been recognised for a long time that a laminar boundary layer over as large as possible a part of the wing chord entails advantages. This fact led to the evolution of a series of so-called laminar-flow aerofoil sections (Fig. 5), which have their greatest thickness at 40 to 60 per cent. chord. This development is by no means yet terminated. Lately it has gained in importance in conjunction with boundary-layer suction at a point about 70 per cent. along the chord, especially as, in connection with very thick sections (of 30 to 40 per cent.) such as are used for tailless aircraft, it enables favourable L/D ratios to be attained (Fig. 6 ; R. & M. 2111, 2149). But even laminar sections can have a laminar boundary layer only when the wing surface is perfectly smooth. The presence of dust particles or collision with insects in flight can cause the boundary layer to become turbulent and incur an increase in drag. The British National Physical Laboratory consequently conducted tests with spanwise suction slots at 20 per cent. chord, which revealed that such turbulence can be restored to laminar flow downstream of these slots (Fig. 7). During these tests a new method was applied to render visible the boundary layer. Prior to the wind-tunnel test the wing, bearing small conical and cylindrical excrescences on the leading edge to create turbulent wake, was given a thin coating of china clay and then sprayed with oil of wintergreen; as the latter dried quicker in the turbulent areas (due to the better mixing), it showed these areas white, contrasting with the still dark and oily surface of the laminar area (R. & M. 2267). We shall conclude by mentioning the boundary-layer investigations being made on control surfaces of different chord (T.N. 1574 ; and others).

(To be continued next month.)

ERRATUM

In the article entitled " Paris Sidelights " in our July issue page 410, it is erroneously stated that the French manufacturer of accessories, Société Air Equipement, exhibited at the Paris Salon " fuel injection pumps specially designed for the SNECMA 14 R 14-cylinder twin-row radial. " The fuel injection pumps for this engine are manufactured exclusively by the next firm to figure on the list, *S. A. Bronzavia*, and were exhibited solely on that firm's stand.

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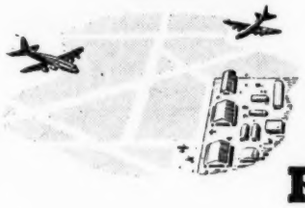

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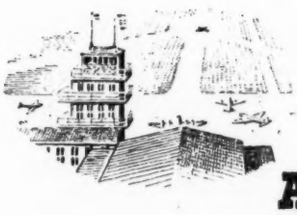

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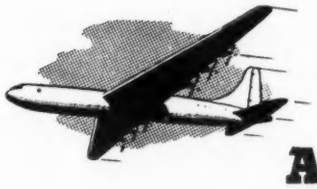

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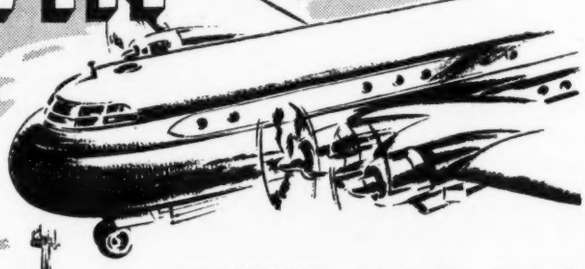

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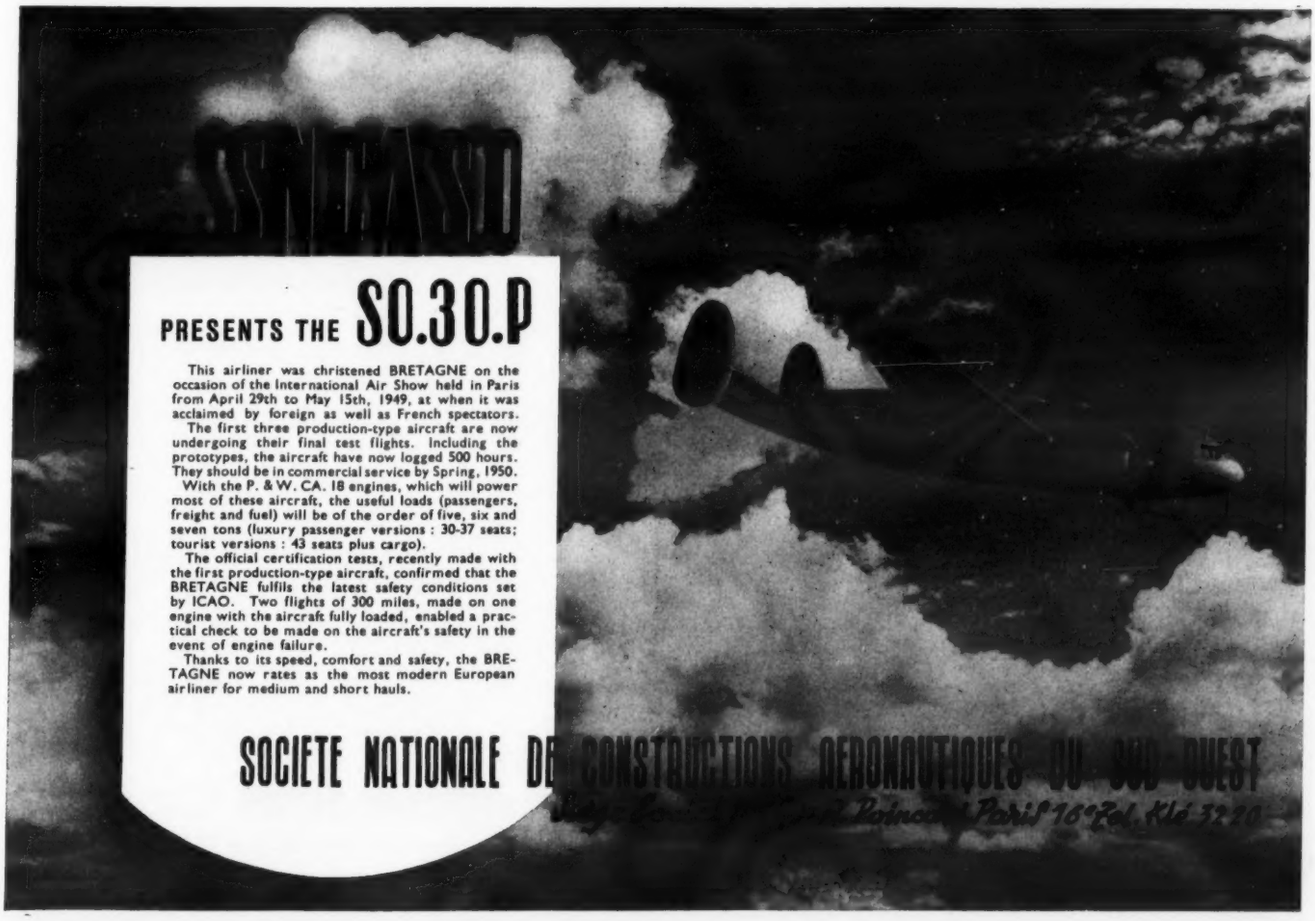
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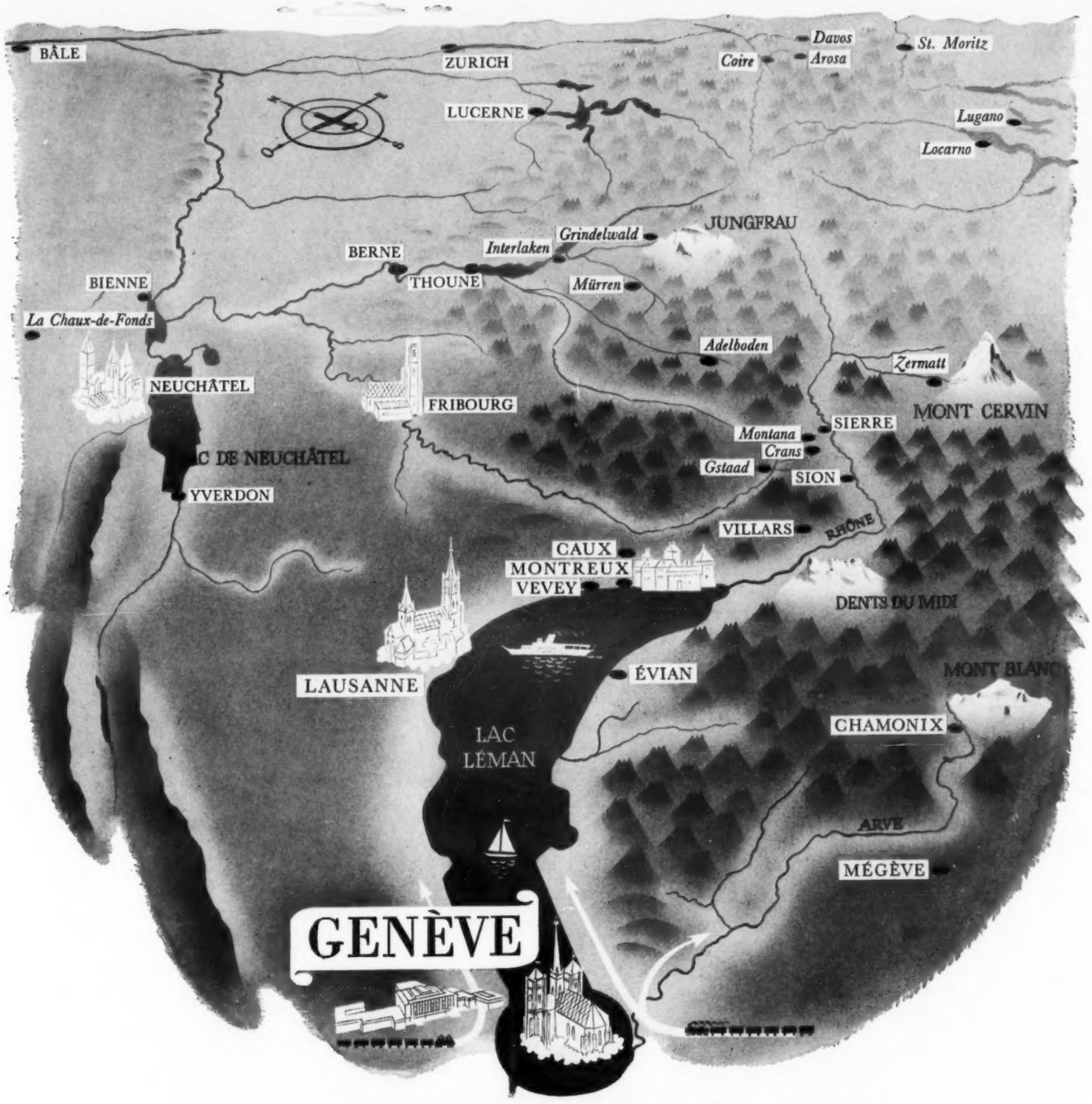

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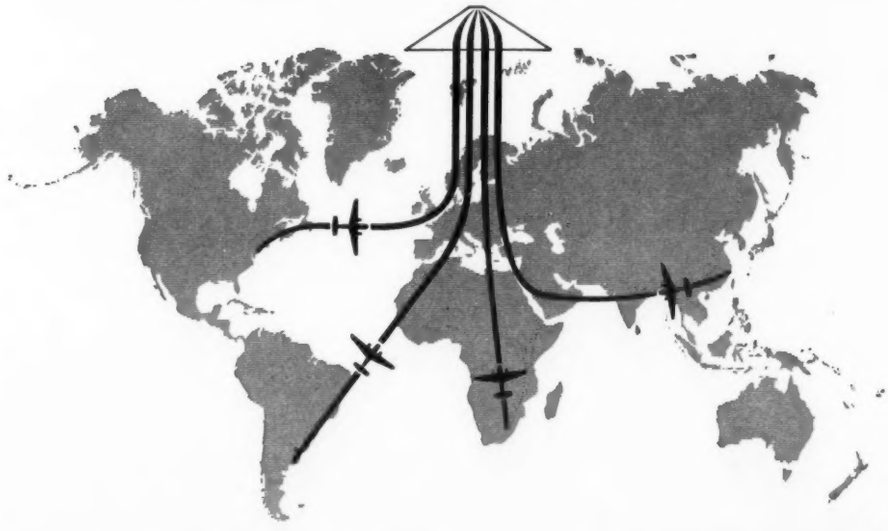

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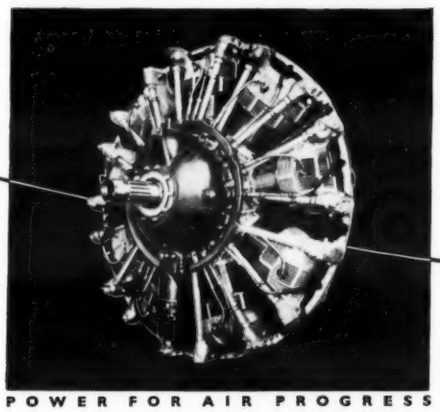

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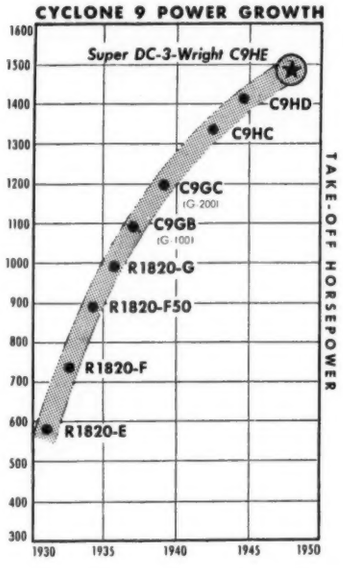

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